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OVERVIEW, INVENTORY, AND ASSESSMENT OF CULTURAL RESOURCES IN THE LOUISIANA COASTAL ZONE

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PREPARED BY:

R. Christopher Goodwin & Associates, Inc.
5824 Plauche Street
New Orleans, LA 70123

PREPARED FOR:

Coastal Management Division
Department of Natural Resources
625 North Fourth Street, Room 1315
State Land and Natural Resources Building
Baton Rouge, LA 70802

PAUL V. HEINRICH

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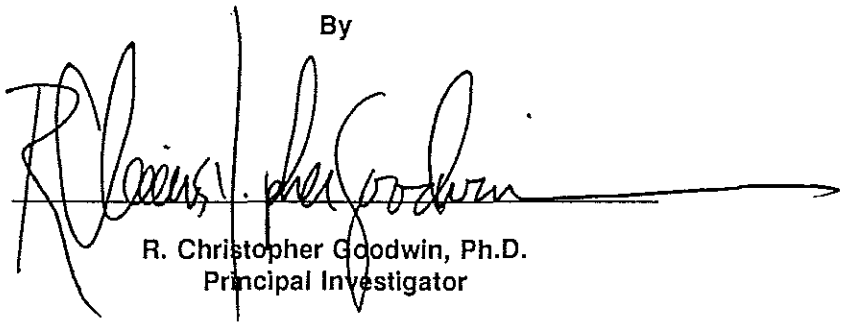
By



R. Christopher Goodwin, Ph.D.
Principal Investigator

With

Paul Heinrich, William P. Athens, and Stephen Hinks

R. Christopher Goodwin & Associates, Inc.
5824 Plauche Street
New Orleans, LA 70123

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CHAPTER I

INTRODUCTION

This report presents the results of an overview and assessment of cultural resources found within the Louisiana Coastal Zone. This study was conducted from January to December 1990 by R. Christopher Goodwin & Associates, Inc., for the Louisiana Department of Natural Resources, pursuant to SFP No. 25101-90-09 (Appendix I).

The objective of this study was to review and summarize what currently is known about the archeological geology of the coastal zone. The coastal zone, as defined by Act 361 of 1978 and amendments, includes all or part of 16 Louisiana parishes. These parishes include: Cameron, Iberia, Jefferson, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Mary, St. Tammany, Tangipahoa, Terrebonne, and Vermilion parishes. This study provides an evaluation of previous research conducted within the area, and it addresses research issues pertaining to site location and distribution throughout the coastal zone. It is intended to provide useful information needed by the Department of Natural Resources to predict, identify, manage, and protect the coastal zone's valuable archeological inventory.

The initial Scope of Services outlined three tasks. Task 1 provided for inventory of known cultural resources within the coastal zone, resulting in compilation of a map atlas. Task 2 entailed review of previous work within the coastal zone, to include not only a description of efforts, but also results. Finally, Task 3 required preparation of an analysis of the current level of knowledge with respect to cultural resources of the coastal zone.

A review of the Scope of Services with the Department of Culture, Recreation and Tourism, Division of Archaeology determined that the data required to complete Task 1 was too sensitive to be released to the general public. Discussions with Dr. Kathleen Byrd at the Division of Archaeology and with Mr. Gregory Ducote of the Department of Natural Resources, Coastal Management Division, determined that Task 1 would not be performed; time allocations would be split evenly between Tasks 2 and 3. As a result, this study provides an overview of how dynamic sedimentological and historic processes within the coastal zone have interacted to alter the original distribution of archeological deposits, and to produce the distributional patterns recorded in the state archeological files. Thus, the initial emphases of this work were examination of the geomorphology and Quaternary geology of the region, and identification of specific geomorphological study areas. The results of this initial study then were integrated with existing research pertaining to aboriginal settlement patterns, in order to assess site formation and destruction processes.

In order to review and summarize what currently is known about the archeological geology of the Louisiana Coastal Zone, this report examines four major topics: (1) natural and cultural processes affecting site preservation; (2) effects of sedimentary processes in the formation and destruction of archeological deposits; (3) the relationships between Louisiana geomorphology and archeological site locations; and, (4) an estimation of the potential for encountering buried resources within the Louisiana Coastal Zone.

Organization of the Report

The archeology and cultural history of the Louisiana Coastal Zone are briefly reviewed in Chapter II. This chapter provides a chronological setting for interpreting man's interactions with the southern Louisiana environment. An overview of the geomorphology and Quaternary Geology of the Louisiana Coastal Zone is provided in Chapter III. In Chapter IV, individual geomorphic regions are defined and described, and gross occurrences of archeological deposits within each of the four physiographic regions

are identified. A discussion of the archeological geology of each physiographic zone with discussions pertaining to site potential is presented in Chapter V. Finally, a summary and conclusions section reviewing the findings of this research is presented in Chapter VI.

CHAPTER II

PREHISTORIC OVERVIEW

by Steve Hinks and Bill Athens

Introduction

The cultural sequence of Louisiana traditionally has been divided into three stages: the Paleo-Indian, the Archaic (Meso-Indian), and the Neo-Indian. These stages, defined by certain technologic and/or economic traits, imply evolutionary development. While a systems approach may be more useful for describing culture areas, these stages provide an accurate organization of cultural information on a chronological scale. Therefore, this three-stage system is utilized in this report to organize the prehistory of the area.

Paleo-Indian Stage (10,000 - 6000 B.C.)

Paleo-Indians, the earliest inhabitants of Louisiana, may have arrived in the region as early as 12,000 B.C. However, the earliest Paleo-Indian remains found in the state date from 10,000 B.C. (Webb et al. 1971; Smith et al. 1983). Information pertaining to Paleo-Indian life-ways is sketchy, but it generally is agreed that they formed highly mobile band level groups that relied on hunting now-extinct Pleistocene megafauna (e.g., mammoth, mastodon, and bison), and on foraging.

The lithic tools composing the Paleo-Indian tool inventory reflect this dependence on big game hunting. The tool kit includes large, thin, bifacially-worked fluted lanceolate projectile points, bifacial cleavers, core handaxes, knives, drills, end scrapers, side scrapers, and spokeshaves (Smith et al. 1983). Lithic tools exhibit high quality workmanship, showing evidence of fine flaking, retouching, basal grinding, and thinning (Smith et al. 1983). Paleo-Indian projectile point types recovered from Louisiana include Angostura, Clovis, Dalton, Eden, Pelican, Plainview, San Patrice, Scottsbluff, and Quad.

Near the end of the Pleistocene, the climate warmed and the herds of megafauna declined, forcing aboriginal peoples to adapt to the region's developing environment. The late Paleo-Indian tool assemblage reflects this adaptation. While the early Paleo-Indian tool assemblage primarily consisted of projectile points manufactured from exotic materials, late Paleo-Indian tools included knives, scrapers, chisels, gravers, drills, and adzes, most of which were made from locally available materials. In addition, overall projectile point size decreased, indicating a greater reliance on smaller game, such as deer. Finally, Late Paleo-Indian sites have been found in greater numbers, suggesting a population increase (Neuman 1984).

Around 8000 B.C., a technological complex known as San Patrice first appeared in northwest Louisiana, east Texas, and southern Arkansas (Webb et al. 1971). San Patrice sites date from 8000 to 6000 B.C.; they initially were defined on the basis of two projectile point types: one lanceolate (San Patrice *var. Hope*), and one side-notched (San Patrice *var. St. Johns*) (Webb 1946). Unifacial tools such as Albany side scrapers and other side scrapers, end scrapers, gravers, drills, raclettes, scaled pieces, burins, and retouched flakes also compose the San Patrice tool inventory (Webb et al. 1971).

San Patrice appears to have been contemporaneous with the Dalton complex recognized in adjacent states. Close technological and morphological affinities between the San Patrice and Dalton complexes have led some archeologists to suggest that these sites are related and comprise the Dalton horizon (Ensor 1986).

In Louisiana, Paleo-Indian finds occur most commonly in the Tertiary uplands and the uplands/floodplain bluff areas. Areas within the more recent floodplains of the Atchafalaya, Mississippi, and Red Rivers or their tributaries generally are considered the least probable areas for locating Paleo-Indian remains (Neitzel and Perry 1977). Most Paleo-Indian projectile points found in Louisiana have been recovered from the surface of sites in the northwest portion of the state. However, some Paleo-Indian artifacts have been found at coastal Louisiana sites.

The Salt Mine Valley site (16IB23), on Avery Island in Iberia Parish, includes an apparent deeply buried Paleo-Indian component. During the 1860s strip mining of the salt dome, deeply buried lithic tools and basketry fragments purportedly were recovered in association with remains of extinct fauna, including mastodon, mammoth, horse, bison, and sloth. Limited testing at the site in the early 1960s produced undiagnostic tools and bipolar chipped cores at depths of approximately 6 m (20 ft). While the original analysis of collected data suggests that initial occupation of the site dates from the early Paleo-Indian period (Gagliano 1964), subsequent analysis suggests that the site may not have been occupied until late in the Paleo-Indian stage (Gagliano 1967).

San Patrice and Dalton sites are more widely distributed than earlier Paleo-Indian sites. San Patrice sites have been found on margins of upland terraces overlooking river valleys, lakes, and streams, and along small streams that dissect the uplands. South Louisiana sites with San Patrice or Dalton components include the Da Dump site (16SL59), and the Edwin Mott site (16SL42), both in St. Landry Parish (Smith et al. 1983). San Patrice points also have been recovered from Avery Island (Gagliano 1964, 1967). No Paleo-Indian artifacts have been recovered from southeastern coastal Louisiana, since the formation of that area occurred after this time period.

Meso-Indian (Archaic) Stage (6000 - 1000 B.C.)

During the Archaic stage, subsistence systems became more diverse, fostering the development of quasi-permanent settlements (Neitzel and Perry 1977). The size, content, and distribution of Archaic sites suggest that site occupation corresponded to seasonal availability of select natural resources. Archaic peoples exploited a home range delimited by the seasonal availability of nuts, fruits, fish, game, and other natural resources (Muller 1983).

Archaic peoples utilized a variety of materials for tool manufacture. They also incorporated new techniques for polishing and grinding granitic rock, sandstone, slate, steatite, and scoria. Shell and bone were used throughout the latter half of the Archaic stage. A wide variety of side-notched, corner-notched, and side-stem projectile points are associated with the Archaic stage.

Early Archaic (6000 - 5000 B.C.)

Early Archaic peoples exploited a wider variety of resources than their Paleo-Indian predecessors. They hunted smaller animals such as whitetail deer, raccoon, bear, dog, groundhog, squirrel, fox, beaver, bobcat, skunk, mink, muskrat, porcupine, wild turkey, passenger pigeon, goose, duck, and various aquatic and semiaquatic species (Walthall 1980; Neuman 1984).

Late Paleo-Indian and Early Archaic projectile point styles such as Angostura-like, San Patrice, and Dalton have been found throughout Louisiana; however, very few Early Archaic components have been isolated within the state. Several Early Archaic projectile point types and associated horizons have been defined for areas throughout the southeastern United States; these include the Big Sandy, Kirk, and Bifurcate Horizons.

The Big Sandy Horizon is characterized by a distinctive projectile point type. Big Sandy points have been found from Florida to Texas in the Southeast, and as far north as the Great Lakes. The Big Sandy point has steep triangular blades and serrated edges. Side-notching and utilization of a similar chipped stone tool assemblage suggests continuity with Dalton and San Patrice. Big Sandy sites also exhibit multiple activity areas (Walthall 1980).

The Kirk Horizon is characterized by a wide variety of stone tools and projectile points associated with the forested portions of eastern North America. The projectile point varieties are medium-sized, corner-notched, and deeply serrated; they often exhibit beveling along the blade. The chipped stone tool assemblage of the Kirk Horizon is similar to that of the preceding Big Sandy Horizon. A substantial inventory of wood and bone working tools is associated with the Kirk Horizon (Purdy 1973; Waller 1976).

The Bifurcate Horizon is identified by small, bifurcated-stem projectile points usually with serrated edges. Distribution of these points throughout the eastern United States is similar to the distribution of points of the preceding Kirk Horizon (Walthall 1980). The Bifurcate Horizon generally has not been recognized in Louisiana.

Early Archaic cultural manifestations resemble those defined for the terminal Paleo-Indian stage in content and distribution. Terminal Paleo-Indian sites in Louisiana often are identified as basal components on Early Archaic sites, indicating an in situ development for the Early Archaic (Servello 1982).

Middle Archaic (5000 - 3000 B.C.)

Middle Archaic cultural manifestations generally correspond with the Hypsithermal Interval. During this time, the climate changed from cold and moist to gradually warmer and drier. By 3000 B.C., climatic and environmental conditions were much like those of the present. The scheduling of economic activities in the southeast shifted at that time to include shellfish (Walthall 1980). A new emphasis on aquatic and riparian resources (shellfish, fish, reptiles, and amphibians) indicates a trend toward maximization of local resources (Smith et al. 1983).

In the southeast, population estimates show an increase over previous levels; however, these larger groups appear to have been less mobile than earlier populations (Muller 1983). Two settlement pattern types have been identified for the Middle Archaic: (1) a centrally-based wandering pattern from both base and satellite camps, and (2) a restricted wandering pattern. In the centrally-based wandering pattern, the central base camp was occupied for both subsistence and maintenance activities; satellite sites were occupied for resource procurement. The restricted wandering pattern involved no base camp; groups moved from one locale to the next as resources became available.

Middle Archaic artifact assemblages of the southeastern cultural area are characterized by a plethora of stemmed, broad-blade projectile points; these probably were used in conjunction with the atlatl (a spear thrower). Middle Archaic projectile points recognized from sites in northwestern Louisiana, northeastern Texas, and southwestern Arkansas include Yarbrough, Yantis, Palmillas, Kent, Elam, Keithville, Carrollton, and Morrow Mountain varieties. Heavy grinding and nutting stone tools and tools such as axes, adzes, wedges, and gouges indicate that Middle Archaic peoples were well-adapted to southern hardwood forests. Bone fish hooks, net sinkers, and plummets reflect increasing reliance on aquatic resources.

Middle Archaic manifestations recognized in South Louisiana include the Amite River Phase. The Amite River Phase was defined in the Amite Basin in the upper deltaic region of Louisiana (Gagliano 1963). It represents an adaptation to the upland woodlands and is characterized by earth middens, camp areas, and conical earth mounds. Sites are located on stream valley margins and along beaches and estuaries. Ground stone and bone were commonly used for manufacturing a variety of tools. Local gravels served

as a source for chipped stone artifacts (Gagliano 1967). Williams, Shulma, Kent, Wells, Almagre, and Gary projectile point types were common.

Remains of human burials have been observed at various Middle Archaic sites within the southeastern cultural area. Burials are both flexed and extended, with few or no grave goods (Muller 1983). These simple interments and the lack of grave offerings imply an egalitarian social organization.

Floodplain sites containing thick midden deposits represent quasi-permanent or permanent habitations. Small special activity sites are generally located on floodplain, on terraces, and in upland settings along tributary streams. These sites apparently were chosen for their proximity to selected exploitable resources, including game, nuts, and chert.

Late Archaic Stage (3000 - 1500 B.C.)

The Late Archaic is marked by settlement of previously uninhabited or sparsely populated areas, suggesting an increase in population throughout the Southeast. Macrobands made up of approximately thirty or more people were formed during spring and summer; during the winter, these groups split into microbands to exploit nearby environments (Jenkins and Krause 1986; Muller 1983). Projectile point types recognized from southern Louisiana include various expanding, contracting, and straight stem forms: Yarbrough, Carrollton, Gary, Shulma, Palmillas, Morhiss, Kent, Pontchartrain, Marshall, Webb, Hale, Ellis, Marcos, Wells, Williams, and Frazier. Shell, bone and stone pendants, musical tube pipes, and a variety of other artifacts are associated with the Late Archaic. During the Late Archaic, regional variations intensified, and extensive exchange relationships developed between regions. Subsistence practices were scheduled around the seasonal availability of key species; deer, fish, nuts, and shellfish were of primary importance. Late Archaic peoples probably practiced limited horticulture of such native cultigens as sunflower, marsh elder, and various gourds and squashes.

Archaic-style projectile points commonly are found throughout the state; however, few of Louisiana's discrete, intact archeological deposits dating from the Archaic have been excavated systematically, analyzed, and comprehensively reported (Neuman 1984).

The Banana Bayou Mound (16IB104) at the southern basal edge of Avery Island was tested in 1962. This testing indicated mound construction in two stages. Charcoal recovered from a lens on the surface of the primary mound dated to 2490 B.C. $\pm$ 260 years, nearly a thousand years prior to the estimated beginning of Poverty Point culture. Charcoal also was recorded in lenses within and underlying the primary mound. Its presence suggests the construction of structures on the mound. While few artifacts were located, a number of amorphous fired clay objects were recovered, which were similar in color and consistency with those recovered from Poverty Point and Tchefuncte sites (Gagliano 1967). It is unclear whether this site actually dates to the Late Archaic stage, or to Poverty Point.

Late Archaic manifestations on the marginal deltaic plain at the vicinity of the mouth of the Pearl River are classified within the Pearl River Phase. Here, oyster shell middens are located along the shorelines and estuaries of the coastal area. This phase may represent the earliest coastal occupation of the region, after sea level approximated modern level. Artifacts associated with this phase include various projectile points such as Pontchartrain and Kent, drills, gravers, atlatl weights, boatstones, sandstone saws, and hones, most of which were made from gravels and sandstones collected from nearby Pleistocene outcrops and stream deposits. Shell and bone artifacts such as socketed antler tine points also have been recovered, along with fired clay hearth fragments (Gagliano 1963).

Additionally, Gagliano (1967) proposed a Late Archaic Copell Phase for south central Louisiana. This phase was based on data collected from the Copell site (16VM102), a prehistoric cemetery site in Vermilion Parish. This site originally was excavated by Henry Collins in 1926. Numerous interments were

recovered at that time, including some which were lying on yellow and red pigments (Neuman 1984). Cultural traits from the Copell site subsequently were described by Ford and Quimby (1945). Collins, Ford, and Quimby assigned a Tchefuncte affiliation for the site based on collected artifacts and data, as well as physical anthropological data from the burials. However, since no ceramic sherds were recovered during excavations at Copell, Gagliano (1967) suggested a Late Archaic affiliation. Additional testing is necessary to date accurately the site, and to determine whether or not the proposed Copell Phase is a legitimate, definable south central Louisiana phase.

Neo-Indian Stage

In Louisiana, the Neo-Indian stage is composed of seven distinct culture units: Poverty Point, Tchefuncte, Marksville, Troyville-Coles Creek, Caddo, Plaquemine, and Mississippian. These groups span a time period ranging from 1500 B.C. to historic contact. Neo-Indians first manufactured ceramic vessels and clay objects; they also constructed burial mounds and temple mounds. Horticultural practices intensified; there is evidence of a greater reliance on second line food resources. In addition, use of the bow and arrow became widespread during Troyville-Coles Creek, as evidenced by the presence of smaller projectile points. No Caddo sites are known in the coastal region; Caddo sites are confined to the northwestern portion of the state, and to nearby portions of adjacent states. Caddo culture, therefore, is not discussed in this section.

Poverty Point Culture (1500 - 500 B.C.)

Both the Poverty Point period and culture are named after the type site (16WC5) located in West Carroll Parish, Louisiana. Poverty Point culture is characterized by baked clay balls, a microlithic stone tool industry, and extensive earthworks (Ford and Webb 1956; Webb 1968; Kuttruff 1975). At the time of its construction, the Poverty Point site was the largest earthwork in the Americas. The site is composed of six segmented ridges 50 to 150 feet wide; it is octagonal in shape. Several other Poverty Point mounds are scattered throughout the immediate site area. The largest of these, Mound A, may have been constructed to resemble a bird effigy. Numerous clay balls at the site have been identified as "cooking balls," used after heating to warm liquids; these objects appear to have been substitutes for stone, which is scarce in the lower Mississippi River Alluvial Valley. A microlithic tool industry mirrors the need for conservation of lithic materials. The artifact assemblage at Poverty Point includes tools and resources made from raw materials originating in Alabama, Arkansas, Tennessee, Ohio, Indiana, and Illinois; steatite vessels originating in Georgia and North Carolina; and, copper originating in Michigan. Ceramics from the St. Johns River Valley in Florida appear later in the period.

Poverty Point artifacts reflect an increase in exchange activity, which began during the Middle and Late Archaic periods. The presence of non-utilitarian items, i.e., lapidary work, panpipes, and animal effigies in stone and shell reflect a hierarchical social organization.

Very little subsistence information has been obtained from the Poverty Point site itself. Specialization in the procurement of deer and fish continued from Late Archaic times. Gibson suggests that redistribution, or the centralized collecting and reallocation of economic produce during Poverty Point times, represents an alternative to seasonal movement; in this manner, the need for food year round was met (Gibson 1978). Incipient horticulture may have focused on a variety of cultigens, including sunflower, marsh elder, various Ameranths, Chenopodia, and gourds and squash.

Distributional studies show that Poverty Point sites were located in areas ideal for the intensive exploitation of forest-edge resources. Poverty Point sites typically are distributed linearly along the Mississippi River Valley and three of its major tributaries: the Arkansas River, the Ouachita River, and the Yazoo River. Typical Poverty Point locations include Quaternary terraces or older land masses overlooking

major stream courses, major river levees of active or relict river channels, river/lake junctions, and coastal estuaries or older land surfaces located in the coastal marsh (Neuman 1984; Gagliano and Saucier 1963). The position of the Poverty Point type site on Macon Ridge overlooking Bayou Macon has led some to suggest that the location of the site allowed the inhabitants to exploit, if not control, the flow of trade goods between other communities (Muller 1983; Neitzel and Perry 1977; Smith et al. 1983). Poverty Point sites along the Vermilion River in Lafayette Parish are believed to be representative of a number of chiefdoms responsible for the coordination and redistribution of resources in that area (Gibson 1975). The percentage of inhabitants of the coastal area participating in Poverty Point culture remains uncertain. No Poverty Point sites have been identified in the Bayou Teche/Atchafalaya Basin region.

In southeastern Louisiana, Bayou Jasmine Phase and Garcia Phase sites are Poverty Point sites exhibiting a continuation of earlier Archaic, with the addition of Poverty Point-like traits. Both phases exhibit Poverty Point traits and suggest seasonal and specialized adaptations to marsh environments. Bayou Jasmine Phase sites are located on the western shore of the lake, as well as along natural levee ridges of the Mississippi River distributaries. The phase, named after the Bayou Jasmine site (16SJB2) in St. John the Baptist Parish, is typified by *Rangia* shell and earth middens, by an artifact assemblage that includes Poverty Point baked clay objects, by a lithic subassemblage which does not exhibit the classic Poverty Point microlithic assemblage, and by bone artifacts. Pontchartrain points occasionally are recovered from these sites. Faunal remains recovered from Bayou Jasmine sites include small animals such as muskrats, birds, and fish, along with some deer and bear. Radiocarbon dates from Linsley (16OR40), a Bayou Jasmine Phase shell midden located south of Lake Pontchartrain, cluster around 1740 B.C., very early in the Poverty Point sequence (Gagliano 1963). A thermoluminescence date at the Claiborne site (22HC35) in Mississippi, of 650 B.C. $\pm$ 240 years, may date the phase more accurately (Jeter et al. 1989).

Bayou Jasmine (16SJB2) was discovered in the late 1950s during road construction. Much of the site was buried beneath 1.8-2.4 m (6-8 ft) of marsh and swamp deposits, along a submerged natural levee of a former Mississippi River tributary, near its mouth at Lake Pontchartrain. Artifacts from the site were collected from spoil piles. The limited data collected at that time formed the basis for the Bayou Jasmine Phase of Poverty Point (Gagliano and Saucier 1963; Gagliano 1963; Duhe 1976). In 1974, the site was rediscovered during construction of Interstate 55. Based on field observations, the site extended along either side of the bayou for a distance of at least 91 m (300 ft), and back from the bayou for at least 18 m (60 ft). The observed shell deposits were 5.5 to 6.1 m (18 to 20 ft) thick. Numerous artifacts were collected from spoil piles along a work canal (Duhe 1976). Limited subsurface testing was conducted within a 2.1 by 15 m (7 by 50 ft) steel sheet piling cofferdam, which was constructed around a specified excavation area (Neuman 1976). Based on the analysis of collected faunal and floral remains, the shell midden formed a seasonal coastal occupation site which probably was utilized during the summer months. Numerous fish, turtle, and alligator remains were collected, along with a substantially smaller percentage of mammal remains. Very few bones from migratory birds such as geese and ducks were recovered, suggesting limited late fall and winter occupation of the site (Duhe 1976).

A large quantity of bone fishing equipment was recovered from Bayou Jasmine, along with some wood and plaited cordage. This equipment included fish hooks, fish gorges, fishing line weights, bone projectiles, perforated harpoons, a harpoon finger rest, harpoon float neck valve plugs, and a carved wooden spool probably used for holding cordage. Clay cooking balls also were common. A small quantity of lithic materials were recovered, including primary flake tools and Jaketown perforators. The flakes probably were used primarily for processing riverine resources. A very few items made of non-local materials were recovered. These included two hematite objects (a bead and a probable plummet), a few quartz crystals, and steatite. Three human burials, and an associated dog burial, were located. Duhe (1976) concluded that this site was a seasonal (summer) fishing station, supplemented with harvesting of *Rangia cuneata*, and limited hunting of small mammals and deer. Data from this site provide the most complete information about coastal Poverty Point sites collected to date.

Garcia Phase sites are located along the eastern shore of Lake Pontchartrain. The Garcia site (16OR34), the type site for the Garcia Phase, contained a beach deposit of *Rangia* shells and midden debris. The Garcia Phase artifact assemblage differs substantially from the earlier Bayou Jasmine assemblage. The assemblage lacks Poverty Point baked clay objects, but includes a typical Poverty Point lithic complex. These lithic materials include Pontchartrain, Gary, and Macon points, along with a number of other minor point types. Various cores and blades, large flake scrapers, groundstone objects, schist and gneiss slabs, quartz crystals, cut bone, and non-local lithic materials also are common (Gagliano 1963; Gagliano and Saucier 1963). While no dates have been obtained for the Garcia Phase, an artifact comparison with other Poverty Point sites suggests that this phase post-dates the Bayou Jasmine Phase (Jeter et al. 1989).

Tchula Period/Tchefuncte Culture (500 B.C. - A.D. 300)

The Tchula period is characterized by the first widespread use of pottery, albeit in the context of a Late Archaic-like hunting and gathering tradition and with a Late Archaic-like tool inventory (Neuman 1984; Smith et al. 1983). While the expansive intra-regional trade network may have broken down, an increase in population and an intensification of inter-regional relationships become established during the Tchula period. The Tchefuncte culture was identified at the Tchefuncte Site (16ST1) on the north shore of Lake Pontchartrain, in St. Tammany Parish (Ford and Quimby 1945; Rivet 1973; Weinstein and Rivet 1978).

Within the early Tchula period, Tchefuncte culture evidences the earliest widespread use of ceramics in the Lower Mississippi Valley (Ford and Quimby 1945). Lacking local antecedents in Louisiana, Tchefuncte ceramics may have originated from the Stallings Island and Orange complexes of the Georgia-Florida coast (Speaker et al. 1986). Tchefuncte ceramic assemblages include both plain and decorated wares with soft and chalky paste, and tempered with either sand or clay. A variety of vessel forms occur, many with flat bases or with foot supports. Fabric and cord impressions, punctations, narrow and wide line incisions, and simple rocker stamping decorations commonly appear on these vessels. Tchefuncte Plain, Tchefuncte Incised, Tchefuncte Stamped, Lake Borgne Incised, Orleans Punctated, and Tammany Punctated are common soft-paste ceramic types. Alexander Incised and Alexander Pinched are two common sandy wares (Toth 1977; Rivet 1973).

Late Archaic or Poverty Point projectile point types found in Tchefuncte contexts include Gary, Ellis, Delhi, Motley, Pontchartrain, Macon, and Epps (Smith et al. 1983). Tchefuncte assemblages also include boatstones, grooved plummets, mortars, sandstone saws, bar weights, scrapers, and chipped celts. Socketed antler points, bone awls, fish hooks, and bone ornaments also are associated with Tchefuncte components.

Tchefuncte sites have been classified as coastal middens or inland villages and hamlets. Settlements reflecting coastal adaptations usually are located near the slack-water environments of slow, secondary streams that drain the bottomlands, floodplain lakes, and in littoral settings (Neuman 1984). Coastal site locations seem best suited for exploiting a variety of fresh and brackish water resources (Shenkel 1984), particularly clam, *Rangia cuneata*. Inland sites were oriented towards exploitation of terrace and floodplain habitats; they were less reliant on brackish water resources (Shenkel 1984).

The majority of coastal Louisiana Tchefuncte sites are clustered within the Pontchartrain Basin in the southeast, and around Grand Lake in the southwest. In the Pontchartrain Basin, the sites generally are situated on natural levees and relict beach ridges such as the New Orleans Barrier Island Trend south of Lake Pontchartrain. The chenier ridges in southwestern Louisiana also were settled during this period. No Tchefuncte sites are known within St. Bernard, Plaquemine, and Terrebonne Parishes, reflecting the recency of these landforms (Jeter et al. 1989).

Several Tchefuncte phases are identified within southern Louisiana. The Pontchartrain Phase encompasses the margins of Lake Pontchartrain and Lake Maurepas. It is characterized by a variety of

poorly made sandy wares, including Tammany Punctated *var. Cane Bayou*, Tchefuncte Plain *var. Mandeville*, Tchefuncte Stamped *var. Lewisburg*, Tchefuncte Incised *var. Abita Springs*, Lake Borgne Incised *var. Ponchitolawa*, and Mandeville Stamped *var. Mandeville*. Other artifacts include Pontchartrain and Kent projectile points, clay tubular pipes, bone points, and some Poverty Point-like clay cooking balls (Jeter et al. 1989). The preponderance of freshwater fish remains at sites such as Big Oak Island (16OR6) and Little Oak Island (16OR7) indicates a reliance on aquatic resources (Shenkel and Gibson 1974). Several Pontchartrain Phase sites have been investigated, including Little Woods Middens (16OR1-5); Tchefuncte (16ST1) (Ford and Quimby 1945); Big Oak Island (16OR6) (Ford and Quimby 1945; Shenkel and Gibson 1974; Shenkel 1974, 1980, 1981); Little Oak Island (16ST7) (Ford and Quimby 1945; Shenkel 1974, 1980, 1981); and a component of Bayou Jasmine (16SJB2) (Duhe 1976).

The Beau Mire Phase was identified by Weinstein and Rivet (1978) at the Beau Mire site (16AN17), located west of Gonzales along New River. This phase is characterized by earth midden sites situated along relict Mississippi River meanders or distributaries, including crevasse distributaries. The Beau Mire site is a late Tchefuncte Phase site, probably post-dating the Pontchartrain Phase.

The Lafayette Phase, recognized in the vicinity of Lafayette, Louisiana, is considered a transitional late Tchefuncte phase inspired by Marksville culture (Toth 1977). Lafayette Phase sites generally are situated along the edge of the Prairie Terrace overlooking the Atchafalaya Basin, and along the Bayou Teche/Mississippi River natural levees within that basin. This phase is characterized at the larger sites by circular earthen mounds. For example, Lafayette Mounds (16SM17), the type site for the phase, is located on the Bayou Teche/Mississippi River natural levee (Jeter et al. 1989). It includes three low, conical burial mounds, the largest of which was excavated by Ford and Quimby (1945). Some small Lafayette Phase satellite communities may occur along the Vermilion River (Jeter et al. 1989).

Grand Lake Phase sites occur further southwest, and represent a coastal adaptation (Gagliano et al. 1979). These sites generally are situated between Vermilion Bay and the Grand Lake area, and extend northward along the Vermilion and Mermentau Rivers. They typically are comprised of shell middens. Grand Lake Phase pottery types exhibit substantial differences from other coastal Tchefuncte phases. The sherds are thicker, more poorly made, and preponderantly sand-tempered. Unusual decorative techniques include folded lips, cane stamping, multiple incised lines parallel to the rim, and angular incised lines (Jeter et al. 1989). Morton Shell Mound (16IB3), a very extensive shell mound found near Weeks Island, in Iberia Parish, includes deposits associated with Poverty Point through Plaquemine cultures, with dominant deposits dating from the Grand Lake Phase (Neuman 1972). Examination of faunal and floral remains from Morton Shell Mound suggests that some coastal sites were occupied on a seasonal basis, usually during the summer and autumn, and possibly during the spring (Byrd 1976).

Marksville Culture (A.D. 100 - 400)

Marksville culture, represented by the Marksville site (16AV1), is viewed as a localized version of the elaborate midwestern Hopewell culture (Smith et al. 1983). Burial practices and material goods reflect participation in a trade network identified as the "Hopewell Interaction Sphere" (Struever 1964). Marksville culture is a Lower Mississippi Valley culture complex. Marksville culture is marked by an intensification of ritual associated with mortuary activities, and a resurgence in inter-regional exchange of prestige items (Cantley et al. 1984).

Decorative motifs shared by Marksville and Hopewell ceramics include cross-hatching, U-shaped incised lines, zoned dentate rocker stamping, cord-wrapped stick impressions, bisected circles, and raptorial bird motifs (Smith et al. 1983). Other Marksville traits include a chipped stone assemblage of knives, scrapers, and drills; groundstone atlatl weights and plummets; bone awls and fish hooks; Gary projectile points; and, trade network items made of galena, mica, and copper. Treatment of the dead changed, with the construction of conical burial mounds with log tombs or platforms, and ossuaries. A fairly high level of

social organization is indicated by the presence of log tombs, the abundance of grave goods accompanying interments, and the construction of conical burial mounds and geometric earthworks.

Some archeologists suggest that Hopewellians relocated to the Marksville culture area because of similarities in Marksville and Hopewell cultures (mound construction, burial patterns, and ceramics) (Muller 1983). Maize appears to have been introduced into the region; it probably first was utilized regionally by Marksville peoples (Walthall 1980). Maize and previously domesticated plant varieties, particularly pioneer annuals and other tropical cultigens such as squash and gourd, supplemented intensive riverine subsistence pursuits (Struever and Vickery 1973).

Marksville sites generally are located on higher ground adjacent to rivers, or along floodplain lakes. Settlements were located along natural levees of rivers and distributary channels in the Mississippi Valley. Most Marksville sites are found within the Lower Mississippi Valley, along the Mississippi escarpment of Macon Ridge (Smith et al. 1983; Neitzel and Perry 1977). Houses were circular, fairly permanent, and possibly earth-covered.

Three basic types of Marksville sites have been identified within coastal Louisiana. Multiple mound ceremonial complexes usually were situated at the confluence of trunk channels and major crevasse distributary streams. These strategic locations were trade and communication centers providing ready access to a variety of environmental zones for exploitation of food resources. Satellite residential communities, often featuring a single mound, were situated along the natural levees between stream junctures. Small seasonal resource procurement sites were scattered around the satellite communities to enhance efficiency of obtaining food resources (Jeter et al. 1989). Relict crevasse splays probably formed favored locations for satellite communities.

Few Marksville sites are recorded within the coastal zone; most of these represent minor components within sites. For example, very few Marksville sites are known from around Lake Pontchartrain, possibly reflecting a relative abandonment of the area from Tchefuncte to Marksville times. Most of the Lafourche and Plaquemine parishes do not contain Marksville sites, reflecting the recency of these landforms. Excavations at coastal Marksville sites have been limited to a few mound sites such as Coquille (16JE37), Boudreaux (16JE53), Big Oak Island (16OR6), and Magnolia Mound (16SB49); data collected at these sites primarily reflect mortuary practices rather than the daily life-ways of the Marksville culture (Jeter et al. 1989).

Several Marksville phases have been identified tentatively in the coastal region. These phases are based on geographic location, and on differences in ceramic assemblages. However, considerably more data are necessary to define better the geographic extent and characteristics of these phases. Three tentative phases have been identified within southeastern Louisiana. The LaBranche Phase, in the Pontchartrain Basin, is an early Marksville phase usually recognized as a minor component at earlier Tchefuncte sites. The Marksville components at Tchefuncte (16ST1), Big Oak Island (16OR6), and the Little Woods Middens (16OR1-5) are recognized as part of the LaBranche Phase. The Magnolia Phase is a late Marksville phase identified within the St. Bernard Deltaic Complex, especially along Bayou La Loutre. These sites typically also include Coles Creek and Plaquemine components. The Coquille Phase, named after Coquille (16JE37), tentatively has been identified within the Barataria Basin south of New Orleans. The validity of this phase has not yet been confirmed (Phillips 1970; Jeter et al. 1989; Beavers 1977).

In the Teche and saltdome region of south central Louisiana, early Marksville sites are classified as Jefferson Island Phase sites, while late Marksville sites are classified as Mandalay Phase sites (Toth 1977). Tentative southwest coastal phases include the early Marksville Lacassine Phase identified at Strohe (16JD10), in Jefferson Davis Parish; the late Marksville Veazey Phase recognized in the Grand Lake region; and the late Marksville Lake Arthur Phase in the Lake Arthur region. Additional data are necessary to define more fully these phases (Jeter et al. 1989).

Troyville-Coles Creek Culture (A.D. 400 - 1100)

The Troyville period first was identified by Ford (1951) as a late Marksville - early Coles Creek manifestation. Another widely recognized name for the Troyville period is "Baytown" (Phillips 1970). Troyville represents a period defined by ceramics and temple mound construction (Gibson 1982a; Gibson 1978). Troyville culture, named for the now largely destroyed Troyville mound group (16CT7) in Catahoula Parish, emerged around A.D. 400. Troyville marks the end of a general subsistence pattern that began in Archaic times; although various groups experienced periods of cultural efflorescence (Poverty Point, Marksville), these occurred within an Archaic milieu (Gibson 1978). Two technological advances associated with the early part of the Troyville period radically altered prehistoric lifeways; maize agriculture and the bow and arrow (Smith et al. 1983). Furthermore, the appearance of temple mounds and large ceremonial structures reflects the emergence of a priestly social class; such a class could not have existed without a stable economic base to support it (Smith et al. 1983).

Although sometimes viewed as two distinct periods, Troyville and Coles Creek have similarities and interconnections that warrant their study as a single unit of Louisiana prehistory. For the purposes of a cultural chronology, it is unprofitable to attempt to separate Troyville from Coles Creek culture. "Indeed, one gets the impression that the distinctions between the two are insignificant, and that the dividing line between them quite arbitrary (Belmont 1967:27)."

During the Troyville-Coles Creek period, population increased throughout coastal Louisiana. This increase is reflected in both the size and number of sites in the area. Wetland niches exploited during earlier Tchefuncte times were re-inhabited during Troyville-Coles Creek times; however, subsistence pursuits differed (Gibson 1978). Smaller mammals and larger aquatic reptiles and fish were exploited during the later period. It has been suggested that the bow and arrow led to a higher hunter success ratio during Troyville-Coles Creek times (Gibson 1978). Fresh, brackish, and salt water environments were inhabited. Mussels, particularly *Rangia* sp., supplemented horticulture and hunting pursuits. Intensive exploitation of plants, and slash-and-burn horticulture, contributed to sedentism and community autonomy (Gibson 1978). Subsistence was varied and adaptable to different locations during this time. Settlement patterns in the coastal estuarine areas remained similar to those utilized by the preceding Late Archaic through Marksville cultures; the primary differences were expressed in the ceramic assemblages (Jeter et al. 1989). Coles Creek sites primarily were situated along stream systems where soil composition and fertility were favorable for agriculture. Natural levees, particularly those situated along old cutoffs and inactive channels, appear to have been the most desirable locations (Neuman 1984).

While there were regional differences between Troyville-Coles Creek subsistence and settlement patterns, certain ceramic styles were widespread. Extensive interaction with other groups living along the coast, particularly with Weeden Island cultures in Florida, are apparent (Brown 1984). Coles Creek Incised ceramics are typical of this culture. They are characterized by a series of incised lines below the rim of the vessel, and by a series of triangles impressed beneath the incised lines. Other ceramic types include Beldeau Incised, French Fork Incised, Mazique Incised, and Pontchartrain Check Stamped. Pottery styles show popularity differences; Pontchartrain Check Stamped proliferated in the coastal region (Gibson 1978). The number and variety of ceramics reflect an increase in the size and complexity of the culture:

> . . . there is an increase in the absolute number of components and in the size of corresponding pottery assemblages assignable to the Middle Coles Creek period. This change probably reflects a population increase and a broader range of adaptations to the various settings in the region . . . (Fuller 1985).

Coles Creek culture is characterized by large flat-topped pyramidal mounds arranged around an open plaza. These served both as burial mounds and as building platforms. Structures built atop the mounds typically were constructed of wattle and daub. Village areas, located away from ceremonial centers, consisted of circular houses. This pattern suggests a change in social, political, or religious concepts. Gibson postulates that Coles Creek sites having horticultural subsistence bases required compensatory adjustments in man-land relationships and in social and political institutions (Gibson 1978). During Coles Creek times, status probably was conferred by differential access to prime agricultural lands.

Most large Coles Creek sites contain one or more mounds. Coles Creek mounds typically are larger, and exhibit more building episodes than earlier Marksville burial mounds. Burials occasionally are recovered from Coles Creek mounds; however, their primary function appears to have been ceremonial. At some Coles Creek sites, mounds are connected by low, narrow causeways; sometimes, multiple mound sites are associated with plazas.

The complexity of Coles Creek mound systems suggests a more complex social structure; a centralized authority and sizable labor force must have existed to build, maintain, and utilize these mounds. The centralized authority probably was a special religious class; the general population occupied the region surrounding the large ceremonial centers (Smith et al. 1983; Neuman 1984).

Small Coles Creek sites consist mostly of hamlets and shell middens, which normally do not contain mounds. Coles Creek shell middens commonly occur in the coastal region on higher portions of natural levees (Springer 1974).

Recognized phases in southeastern Louisiana include the Troyville Period Whitehall Phase; the early Coles Creek Bayou Cutler Phase; and, the late Coles Creek Bayou Ramos Phase. South central Louisiana phases include the early to middle Coles Creek White Lake Phase, and the late Coles Creek Morgan Phase. Roanoke is the recognized Troyville phase in southwestern Louisiana. Welsh corresponds temporally to Bayou Cutler, and Jeff Davis Phase dates from the late Coles Creek period.

The end date of Troyville-Coles Creek is ca. A.D. 1100; however, like most other dates, it does not imply a sudden termination of that cultural period. No sharp division occurred between Troyville-Coles Creek and the cultures that succeeded it. Phillips' (1970) discussions on the complexities of Baytown ceramics, which are found to span Marksville, Coles Creek, and later cultures, aptly demonstrate this point.

Plaquemine Culture (A.D. 1100 - 1700)

In the Lower Mississippi Valley, the indigenous Plaquemine culture emerged from Coles Creek by A.D. 1100. Plaquemine culture continued the same lifestyles as the previous Coles Creek cultures, with the exception that agriculture seems to have become more important. Ceramics were tempered with a variety of materials, including shell. Brushing became the most common decorative technique; however, earlier decoration techniques persisted. Engraving became popular later during this period (Smith et al. 1983). Plaquemine Brushed, Harrison Bayou Incised, Hardy Incised, L'Eau Noire Incised, Manchac Incised, Mazique Incised, Leland Incised and Evansville Punctate are common ceramic types of the Plaquemine culture. Rectangular house structures were constructed of wattle and daub. Site locations favored the levees and margins of the alluvial valleys. Settlement patterns reflected dispersed villages or hamlets surrounding ceremonial centers. These settlement patterns remained basically unchanged from earlier Troyville-Coles Creek times (Smith et al. 1983). Salt mining at Avery Island became an important part of the Plaquemine culture. The importance of salt in the trade and subsistence networks of Plaquemine culture continued into the historic period.

Plaquemine culture represents an indigenous development that emerged from Coles Creek. Plaquemine peoples continued the settlement patterns, economic organization, and religious practices

established during the Coles Creek period; however, agriculture, socio-political structure, and religious ceremonialism intensified. Plaquemine sites are characterized as ceremonial sites with multiple mounds surrounding a central plaza, and dispersed villages and hamlets (Smith et al. 1983).

Plaquemine culture derives its name from the city of Plaquemine, Louisiana, situated near the type site, Medora (16WBR1), which was excavated by Quimby (1951). This site is a ceremonial center located on the Mississippi River floodplain at Manchac Point, south of Baton Rouge. Two mounds at the site were excavated and recorded. Mound A was constructed in four stages. The pre-mound stage represented the original living surface and associated features. The features included two circular house or temple rings measuring 13.7 m (45 ft) and 7.6 m (25 ft) in diameter; several pits; and, hundreds of postmolds. The second stage of Mound A construction was an ovoid mound 30 m (100 ft) in diameter and 0.3 to 0.6 m (1 to 2 ft) high; this mound contained some shallow pits, and many postmolds, some of which formed the square corner of a structure. The third stage of Mound A construction involved the addition of two truncated pyramidal mounds upon the initial mound, with a structure at the summit of each. During the fourth and final stage of construction of Mound A, a 38.1 to 39. 6 m diameter (125 to 130 ft), 3 m (10 ft) high truncated pyramidal mound was built over the earlier mound complexes.

Mound B was separated from Mound A by an approximately 122 m (400 ft) plaza. It also was ovoid and very similar to the initial mound at Mound A, and it covered one or two pre-mound constructions (Quimby 1951). Based on these excavations, Quimby developed a trait list to characterize Plaquemine culture. These traits included the construction of truncated, pyramidal (platform) mounds in association with an adjacent plaza; mounds built in stages; square or circular buildings (temples) associated with mounds; and, a distinctive pottery assemblage characterized by a comparatively high proportion of plain dishpan-shaped bowls, jars with brushed decoration, and plates with interior decoration (Quimby 1951:129).

Another Plaquemine culture ceremonial center reported by Quimby (1957), the Bayou Goula site (16IV11), is situated on the west bank of the Mississippi River, near Bayou Goula, Louisiana. This site, excavated in 1941, consisted of two platform mounds dating from the Coles Creek to Plaquemine stage, and an historic contact component. The mounds had been constructed in stages; the larger mound, Mound 1, had been constructed in three stages. These mounds probably were constructed during prehistoric times, and may not have been used during the early contact period. Aboriginal occupation continued into the early historic period. While the documents are inconclusive, the initial French contact with the aboriginal village at 16IV11 occurred either during Iberville's 1699 exploration of the Mississippi River, or at the time of the 1718 Paris concession (Quimby 1957; Giardino 1984).

Woodiel (1980a, 1980b) describes the 1977-1978 excavations at the St. Gabriel site (16IV128) on the Mississippi River natural levee northeast of St. Gabriel, Louisiana. The St. Gabriel site was a Plaquemine culture ceremonial center. At the time of its excavation, the site included one earthen mound and a largely destroyed adjacent village site. The excavated mound was similar to those excavated at the Medora site and at Bayou Goula. It also was built in stages, and in association with buildings (temples). Woodiel noted two settlement patterns. The St. Gabriel site was located on the backslope of the natural levee of the Mississippi River, between the natural levee crest and the backswamps, and adjacent to a probable prehistoric crevasse (water source). This placed the site near two distinct ecozones, the natural levee and the backswamp, allowing the inhabitants to exploit a wider variety of faunal and floral resources than would be available in a single ecozone. These food resources included large and small mammals, birds, turtles, fish, persimmon, honey locust seeds, and at least some corn. Woodiel notes that other prehistoric sites along the Mississippi River were situated in the vicinity of the cutting bank of a meander loop (Woodiel 1980a, 1980b).

Mississippian Culture (A.D. 1000 - 1700)

Late during the prehistoric period, the indigenous Plaquemine culture was influenced by Mississippian culture. Mississippian influence radiated from the middle Mississippi River Valley to southern Louisiana, into central North Carolina, and north into the Great Lakes region (Haag 1971). Mississippian sites in Louisiana typically are located along the extreme southeastern coast, and in an isolated pocket in the northeastern part of the state. Mississippian culture continued to influence lifeways of southern Louisiana until contact with historic European cultures.

Mississippian subsistence was based on cultivation of maize, beans, squash and pumpkins; collection of local plants, nuts and seeds; and, exploitation of various riverine and terrestrial species. Major Mississippian sites were located on fertile bottomlands of major river valleys; sandy and light loam soils usually composed these bottomlands. A typical Mississippian settlement consisted of an orderly arrangement of village houses surrounding a truncated pyramidal mound. These mounds served as platforms for temples or as homes for the elite. A highly organized and complex social system undoubtedly existed to sustain these intricate communities.

Mississippian ceramics are characterized by shell tempering, an innovation that enabled potters to create larger vessels (Smith et al. 1983:203). Ceramic vessels such as globular jars, plates, and bottles, as well as loop- and strap-handled pots were used by Mississippian peoples. Decorative techniques include engraving, negative painting, and incising; modelled animal heads and anthropomorphic images also adorned ceramic vessels. Other Mississippian artifacts include chipped and ground stone tools; shell items such as hairpins, beads, and gorgets; and mica and copper items.

Historic Contact

Although Hernando de Soto explored parts of Louisiana in the 1540s, it wasn't until the French entered the region in 1682 that the first information was recorded concerning Louisiana's aboriginal population. At that time, five native American linguistic groups occupied southern Louisiana: Natchezan, Muskhogean, Tunican, Chitimachan, and Atakapan.

Natchezan Indians living in southern Louisiana included the Tensa and the Avoyel. The Tensas moved downriver from present-day Tensas Parish in 1706; they eventually settled around Mobile, Alabama and were assimilated by other Indian groups in the area. The Avoyel resided along the Red River near Alexandria and Marksville; by 1805, they no longer existed as a group.

Muskhogeans comprised of the greatest number of Indian groups, including the Houma, the Acolapissa, the Bayougoula, the Tangipahoa, the Okaloosa, the Washa, and the Chawasha. The most prominent of these, the Houma, moved from west Mississippi to the vicinity of Angola, Louisiana. Their neighbors, the Tunica, drove them from that region; a series of migrations brought them to the marshes of Terrebonne Parish, where their descendents reside today. The Acolapissa once lived near the mouth of the Pearl River; they subsequently merged with the Houma and lost their tribal identity. The Bayougoula lived on the west bank of the Mississippi River south of Plaquemine in Iberville Parish. The Tangipahoa lived in southeastern Louisiana. The Okalousa lived in the upper Atchafalaya Basin. The Chawasha and Washa lived along Bayou Lafourche. All Muskhogean-speakers engaged in hunting, fishing, gathering, and agriculture for subsistence.

In 1706, the Tunica moved south from northwestern Mississippi and settled near the confluence of the Mississippi and Red Rivers. By 1800, they migrated to the Avoyelles Prairie around Marksville (Smith et al. 1983).

The Chitimacha controlled much of the upper Barataria Basin along both Bayou Lafourche and the Mississippi River. They were able to survive into the twentieth century largely because of their inaccessible location; the eastern Chitimacha were recorded in the area between the Atchafalaya and the Mississippi rivers as early as 1702. At that time, they inhabited present-day Iberville, Assumption, St. James, Lafourche, St. Martin, and Terrebonne Parishes (Giardino 1984; Swanton 1946). Today the Chitimacha reside along Bayou Teche near Charenton, Louisiana.

In 1700, Attakapan-speakers consisted of approximately 3,450 Attakapas and Opelousa. The Attakapas were thought to be the most primitive American Indian group living in southern Louisiana during the Historic Contact period, since they continued to rely heavily on hunting, fishing, and gathering for subsistence. The Attakapas lived along three rivers in the southwestern part of the state: the Vermillon, the Calcasieu, and the Mermenteau. The lesser-known Opelousa lived near present-day Opelousas, in St. Landry Parish, Louisiana (Smith et al. 1983). Like most other Indian groups of Louisiana, these groups declined drastically during the late eighteenth and early nineteenth centuries, due to epidemic diseases and hostilities (Aten 1984).

CHAPTER III

GEOMORPHOLOGY

by Paul V. Heinrich

Geomorphic Regions

As defined by Hunt (1974) and Thornbury (1965), three physiographic divisions occur within the Louisiana Coastal Zone. The most extensive division is the Holocene deltaic plain. For purposes of this report, the Holocene deltaic plain is subdivided into the Mississippi Delta Plains and the Chenier Plains. The second most extensive division includes the Pleistocene alluvial and deltaic landforms found at the northern edge of the coastal zone. These landforms are cut by the third division, the Holocene alluvial plain, called the Mississippi Alluvial Valley in this report. Both Hunt (1974) and Thornbury (1965) provide general overviews of these physiographic subdivisions. Saucier and Snead (1990) and Snead and McCulloh (1984) also have mapped the regional geology and geomorphology of the Louisiana Coastal Zone.

Mississippi Delta Plains

The Mississippi Delta Plains is a compound geomorphic surface formed by the periodic progradation of delta lobes of the Mississippi and Red Rivers over the past 9,000 years. This surface consists of numerous coalesced or partially buried delta plains that represent the surface of these delta lobes. The surfaces of these delta plains typically exhibit the classic radial pattern of deltaic distributaries, as described in many studies (Coleman 1982).

Based upon the modern physiography of the Mississippi Deltaic Plain, nine major geomorphic subdivisions have been defined for purposes of this study (Figure 1). Four of these geomorphic subdivisions, called the Plaquemine, Terrebonne, St. Bernard, and St. Mary Coastal Regions consist of delta plains in varying stages of subsidence. Two of these subdivisions, the Barataria and Lake Ponchartrain Basins, are water and swamp-filled basins formed by the progradation of deltaic lobes. The last three geomorphic subdivisions, Meander Belt No. 1, Meander Belt No. 3, and Bayou Lafourche Meander Belt, are active or former trunk channels of the Mississippi River that fed the delta lobes which built the Mississippi Delta Plain. Although they extend into this physiographic subdivision, Meander Belts No. 1 and No. 3 are discussed below as part of the Mississippi Alluvial Plain.

Mississippi Chenier Plain

The Mississippi Chenier Plain is a marginal delta plain that stretches about 200 km from South Point, Louisiana to Sabine Pass, Texas (Figure 1). It is a 20 to 30 km wide strandplain that exhibits five major sets of typically east-west trending ridges separated by wide belts of marsh. These ridges consist of sand and shell, and are 2 to 6 m high. This physiographic subdivision comprises the western part of the Holocene Deltaic Plain as described by Hunt (1974) and Thornbury (1965) (Penland and Suter 1989).

Pleistocene Alluvial and Deltaic Landforms

The southern edge of the Pleistocene alluvial and deltaic landforms on either side of the Mississippi Alluvial Valley within the coastal zone, is the lowest and most gulfward of three coast-parallel, geomorphic surfaces (Autin et al. 1988; DuBar et al. 1990) (Figure 1). Each of these three terraces is a low-relief, gulfward-sloping surface separated by low, irregular, coast-parallel scarps. Only the lowest of the terraces, the Prairie Terrace, occurs within the Louisiana Coastal Zone. The Prairie Terrace shows relatively less dissection, less drainage development, and a lower slope and surface elevation than those of the Intermediate and High Terraces, the two coast-parallel terraces to the north. Unlike the other terraces, constructional landforms can still be recognized on the Prairie Terrace. These landforms consist primarily

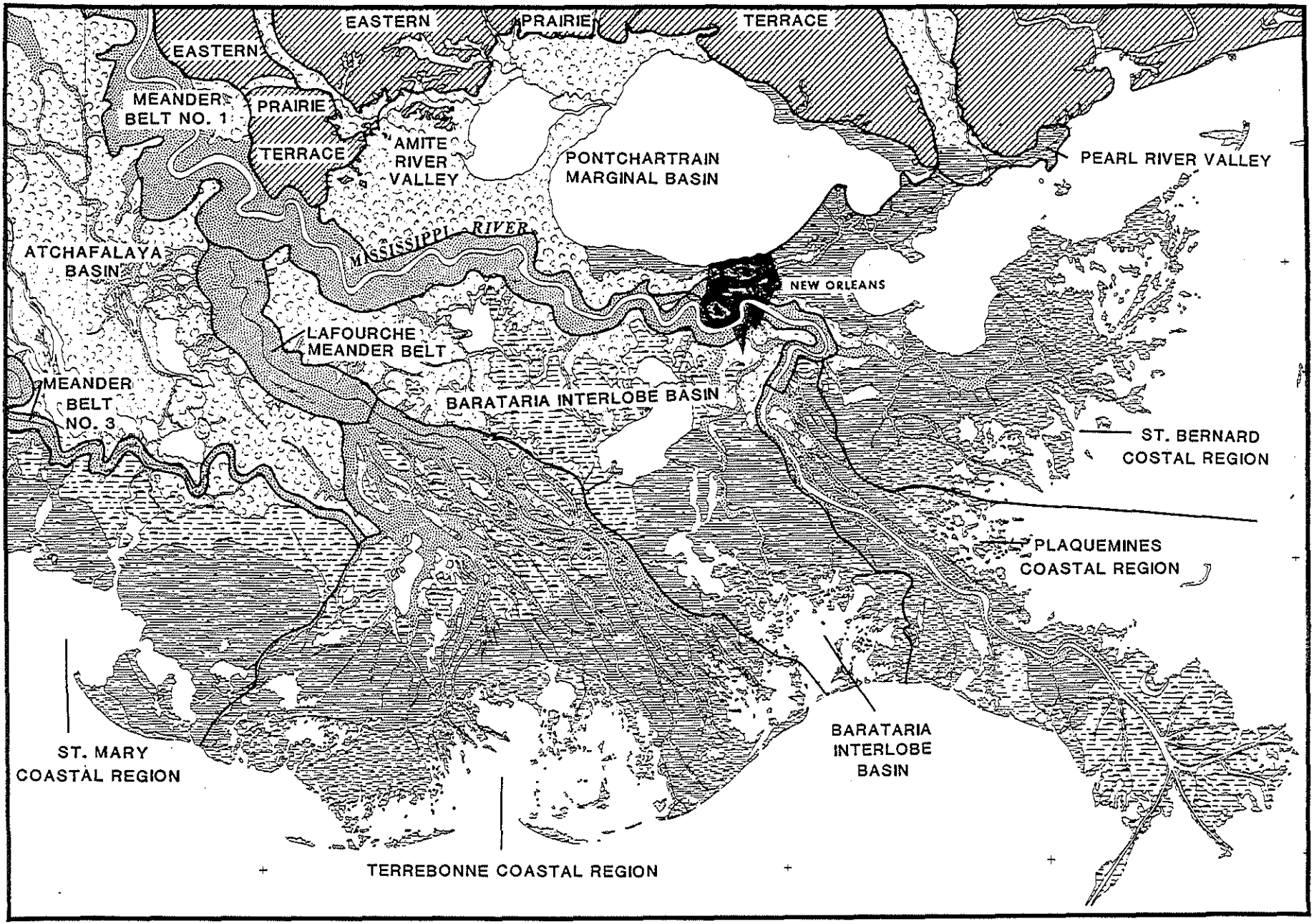


Figure 1. Regional Geomorphic Map of the eastern half of the Louisiana Coastal Zone (Sheet 1).

Note: Change "Lafourche meander belt" to "Lafourche Deltaic Distributary"

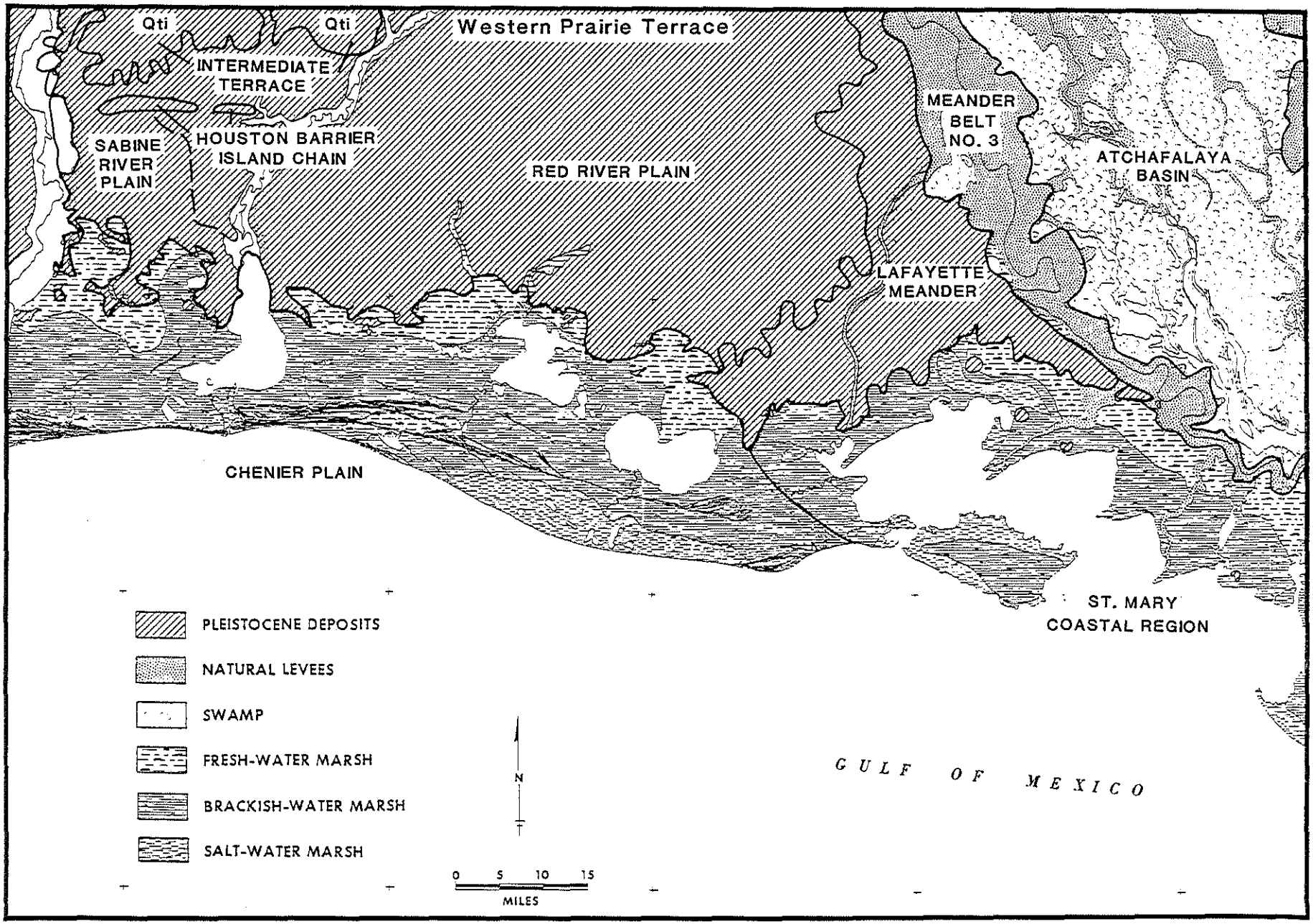


Figure 1. Regional Geomorphic Map of the western half of the Louisiana Coastal Zone (Sheet 2).

of the meander belts and river courses of the Sabine, Red, Mississippi, Comite, Amite, and Pearl rivers, and barrier islands of the Ingleside Strandline (Autin et al. 1988; Autin, Burns et al. 1990; Bernard et al. 1962; Coastal Environments Inc. 1979b; Mossa and Autin 1989; Otvos 1972; Snead and McCulloh 1984).

Mississippi Alluvial Plain

Within the coastal zone, the Mississippi Alluvial Plain is a compound geomorphic surface comprising the plains' two meander belts, the Mississippi and Bayou Teche Meander Belts, and their adjoining flood basin, the Atchafalaya Basin (Figure 1). This part of the Mississippi Alluvial Plain is transitional in character between pure alluvial and deltaic plains. For example, the width of the point bars and meander amplitude of both meander belts decreases and eventually disappears downstream. Also, the Atchafalaya Basin changes along its length from an alluvial flood basin to an interdistributary swamp (Kolb and Van Lopik 1966; Saucier and Snead 1990; Tye and Kosters 1986).

Stratigraphic Methodology

In many parts of the United States, Holocene and Late Pleistocene sediments exist only as a thin veneer of sediment or topsoil overlying either unconsolidated sediments or bedrock that predates human occupation of North America. As a result, archeological deposits typically are restricted to a thin, relatively uncomplicated, layer of alluvium, colluvium, or residuum. The stratigraphy of such deposits for the most part can be described in simple stratigraphic terms, (Stein 1987, 1990), without recourse to the complex assemblage of stratigraphic methodology normally employed by geologists.

However, within the Louisiana Coastal Zone, a thick sequence of deltaic, fluvial, and eolian sediments have accumulated during the Late Pleistocene Stage and Holocene Epoch. The shifting courses and delta lobes of the Mississippi and Red Rivers, and the shifting shoreline of the Gulf of Mexico have deposited a thick and intricately stacked sequence of Late Pleistocene and Holocene coastal, deltaic, and fluvial sediments. Multiple, independent, and formally defined stratigraphic classification systems must be an essential part of the interdisciplinary research approach used to describe, correlate, and interpret the complex succession of Late Quaternary and Holocene sedimentary deposits which have accumulated within the coastal zone (Autin, Snead et al. 1990:21).

Geoarcheologists, archeological geologists, and archeologists working within the coastal zone unfortunately must contend with an intricate system of stratigraphic terms. However, mastery of stratigraphic nomenclature and an understanding of depositional processes is essential for determining how natural processes have modified the archeological record within the coastal zone.

If stratigraphic analysis is going to be of use to archeological research, stratigraphic nomenclature must be more precisely applied than it has been in the past. For example, criteria, in addition to elevation and morphology, need to be used to map the distribution of geomorphic surfaces and to infer their age and origin. Furthermore, the age of a geomorphic surface should not be assumed automatically to be the same as the age of the sediments that underlie it. In addition, the different types of stratigraphic units need to be kept separate and hybridized as previous studies of the geomorphology and Quaternary Geology of the coastal zone often have done. Finally, the use of models that propose simple one-to-one correlation between the formation of individual paleosols, geomorphic surfaces, alloformations, or formations with glacial cycles or sea level fluctuations to date these stratigraphic units should be avoided if at all possible.

Five types of stratigraphic units, geomorphic surfaces (morphostratigraphy), lithostratigraphy, allostratigraphy, pedostratigraphy, and chronostratigraphy, are important to the correlation and dating of Holocene and Late Pleistocene deposits within the coastal zone. Three of these types of stratigraphic units, geomorphic surfaces, lithostratigraphy, and allostratigraphy, are specifically discussed in the following

paragraphs. Two of these types of stratigraphic units, chronostratigraphy and pedostratigraphy, are discussed by Autin, Burns et al. (1990), Autin, Snead et al. (1990), and by the North American Commission on Stratigraphic Nomenclature (1983).

Geomorphic Surfaces

Geomorphic surfaces are a very important aspect of the stratigraphy and archeological geology of the coastal zone. It is upon stable geomorphic surfaces, such as alluvial and deltaic plains, that prehistoric humans lived and upon which archeological deposits accumulated (Gagliano 1984). Because prehistoric humans did not occupy submerged parts of accreting point bars and prograding deltas, archeological deposits will be primarily restricted to subaerial geomorphic surfaces and the sediments which accumulated upon them. Delta plains, strandplains, alluvial plains, fluvial terraces, and coast-parallel terraces are all subaerial constructional surfaces. Any disturbance of these surfaces unavoidably will damage or destroy associated archeological deposits. For example, the formation of geomorphic surfaces, e.g. ravinement surfaces, by shoreface erosion will destroy exposed constructional surfaces and the sedimentary and archeological deposits that form them.

Plains

The entire surface of the coastal zone consists of relatively flat geomorphic surfaces constructed by the aggradation of fluvial, deltaic, or strandplain sediments. Within the coastal zone, a constructional geomorphic surface that is either an active or abandoned part of a modern fluvial or deltaic system is designated a "plain."

An alluvial plain is a geomorphic surface that consists of the active meander belt of a river or stream and its associated flood basins and abandoned meander belts. A meander belt is a surface that consists of an assemblage of constructional landforms created by the meandering of a river occupying a single course. A meander belt consists of depositional landforms such as point bars, natural levees, crevasses, abandoned meander loops, and abandoned river courses. A flood basin, also called a "backswamp", is an area consisting of swamp, lakes, or a combination of both composing the low alluvial plain between meander belts (Saucier 1974:10-11).

A delta plain is the constructional surface of a delta complex. A delta complex consists of the set of delta lobes fed from a common trunk channel. A delta lobe consists of a set of subdeltas and minor distributaries fed from a major distributary (Coleman and Gagliano 1964; Frazier 1967).

Unfortunately, some recent studies within the coastal zone, e.g. Penland et al. (1987:1692), have confused geomorphic surfaces and subsurface sediments by incorrectly extending the definition of a "delta plain" to include both the surface of a delta and sediments that form this surface. By definition, a plain of any type is strictly a geomorphic surface consisting of level or nearly level land. Also, the term "plain" lacks any reference to the deposits that form it. Therefore, in this report, the term "delta plain" is reserved solely for the subaerial, constructional surface of a delta complex.

Terraces

For reasons given below, the term "terrace" is defined as a relatively flat geomorphic surface that is separated from adjacent geomorphic surfaces by a constructional or erosional scarp. Within the coastal zone, two different types of terraces, coast-parallel and fluvial terraces, have been recognized. The coast-parallel terraces are low-relief, gulfward-sloping geomorphic surfaces separated by low, irregular coast-parallel scarps; they parallel the coast, and can be tens of kilometers wide. These surfaces represent relict coastal plains consisting of Pleistocene alluvial and delta plains that have been completely abandoned

(Barton 1930; Bernard et al. 1962). A fluvial terrace is typically a narrow geomorphic surface of purely fluvial origin that parallels an adjacent, modern stream or river. It generally trends perpendicular to the modern coastline.

Unfortunately, many investigators studying the coastal zone confuse geomorphic surfaces, e.g. fluvial and coast-parallel terraces, and the sediments that form them. These investigators use different types of stratigraphic terminology, e.g. terrace and formation, and names, e.g. Prairie; Deweyville; Montgomery; and Williana, interchangeably to refer to both geomorphic surfaces and underlying sedimentary strata. The confused use of the terms "terrace" and "formation" results from the uncritical use of the concepts of Fisk (1944) regarding valley history and evolution. His theory proposed that terrace development resulted solely from the response of fluvial systems to changes in eustatic sea level induced by four glacial-interglacial cycles. As a result, it was assumed that terrace surfaces and the sediments beneath them were synonymous in age and origin, and were interchangeable entities. Because this assumption and the model of Fisk (1944) on which it is based are incorrect, the term "terrace" is reserved herein solely for a relict geomorphic surface as previously defined by Autin, Burns et al. (1990) and Autin, Snead et al. (1990).

Lithostratigraphy

The basic unit of lithostratigraphy is the formation. A formation is defined as a mappable body of sedimentary, volcanic, metamorphic, or plutonic rock which can be distinguished and delineated on the basis of its physical character, lithology, and stratigraphic position without reference to its cultural and paleontological content or age. By definition, a formation is recognized by only the physical properties of the lithified or unlithified sediments that compose it (North American Committee on Stratigraphic Nomenclature 1983:855-858).

Within the coastal zone, numerous attempts have been made to subdivide Pleistocene strata into formations associated with the mapped coast-parallel terraces (e.g. Frink 1941; Jones et al. 1956; Akers and Holck 1957; Solis-I. 1981; McFarlan and LeRoy 1988). These attempts have neither consistently defined subsurface stratigraphic units nor have they demonstrated a correlation between these formations and the coast-parallel terraces. In addition, the formations were defined not by differences in lithology, but rather by local marker beds, paleosols, and unconformities. By the formal definition of a formation, these stratigraphic units are not true formations (North American Committee on Stratigraphic Nomenclature 1983:855-858; Dubar et al. 1990).

A cyclic deposition of fluvial, deltaic, and other coastal sediments during the Holocene and Pleistocene Epochs has resulted in sediments consisting of intricately interbedded sands, muds, and clays. As a result, these sediments lack the lithologic differences necessary to characterize them or differentiate among them on the basis of lithology (Autin, Burns et al. 1990; Dubar et al. 1990). Thus, lithostratigraphy is usually an unusable stratigraphic tool within the coastal zone. However, on the scale of a site, lithostratigraphic units such as the layer, as defined by Stein (1990), are useful in archeological work.

Allostratigraphy

Allostratigraphy is a very important and useful, but often ignored, stratigraphic tool for geomorphological and geoarcheological research in the coastal zone. An alloformation is a mappable body of sedimentary rock or unconsolidated sediments that is defined and identified on the basis of bounding discontinuities. A bounding discontinuity can be either an erosional unconformity or a construction surface (North American Committee on Stratigraphic Nomenclature 1983:865-868).

Within the coastal zone, terraces, meander belts, and delta plains form the upper bounding discontinuity of mappable sequences of Late Quaternary sediments. The lower bounding discontinuity of these sedimentary sequences is defined by an erosional unconformity formed either by fluvial or marine processes. Because these sedimentary sequences are defined and mapped by bounding discontinuities, they are, according to the formal nomenclature of stratigraphic nomenclature, alloformations. However, they have been in the past, and frequently still are, incorrectly called "formations" (Autin 1989; Autin, Burns et al. 1990; Autin, Snead et al. 1990).

Complexes

Unfortunately, few of these allostratigraphic units have been adequately defined or properly named. As a result, the stratigraphy of sediments associated with many geomorphic surfaces within the coastal zone has neither been defined nor named. For such cases, an informal allostratigraphic term, the "complex," is used. A complex consists of a single geomorphic surface or temporally related surfaces, and the unnamed and poorly described sediments associated with it. Typically, the complex is named for a geomorphic surface which forms part of it. The use of a complex is abandoned when it is named and described as a formal allostratigraphic unit (Whitney J. Autin, personal communications 1989; Autin, Snead et al. 1990).

Fluvial Terraces

A fluvial terrace forms the surface of the basic allostratigraphic unit, whether a formal alloformation or an informal complex. Both units consist of a basal bounding discontinuity, a body of fluvial sediments that lies between the bounding discontinuities, and an upper bounding discontinuity (Figure 2). Typically, the basal bounding discontinuity is an erosional unconformity formed by scouring at the channel bottom and at the bank collapse along a cutbank of a channel (Autin 1989). Fluvial materials deposited by this channel overlie the basal unconformity. Generally, but not always, these sediments consist of a lower part, composed of point bar sands and gravels, overlain by finer-grained and vertically accreted natural levee and overbank sediments (Walker 1984). Typically, the upper bounding discontinuity is either an exposed or buried fluvial terrace. However, an upper bounding discontinuity is commonly an erosional unconformity formed during the deposition of a younger alloformation (Autin 1989).

The scarp that defines a fluvial terrace is the surface exposure of the basal unconformity (Figure 2). The scarp as reflected in differences in surface morphology, soil development, and thickness of overbank deposits, separates geomorphic surfaces of differing ages. Also, the terrace scarp separates depositional sequences that form the terraces of fluvial sediments that can differ in type and distribution of facies (Autin 1989).

Meander Belt

Within the Mississippi River Alluvial Plain, the meander belt forms the surface of a basic allostratigraphic unit. As in the case of a fluvial terrace, the unit consists of a sequence of fluvial deposits bounded by a basal erosional surface and an upper constructional geomorphic surface (Figure 2). This type of alloformation has the same sequence of fluvial facies as an alloformation associated with a fluvial terrace. For example, the meander belt surface is formed by variable thicknesses of natural levee and other overbank deposits. However, an alloformation associated with a meander belt retains a larger percentage of its original lateral extent and often cuts only into thick, mostly older backswamp deposits.

Delta Plain

As defined by Frazier (1967), a delta complex forms an alloformation or complex consisting of a lower bounding discontinuity, a regular sequence of deltaic facies, and an upper bounding sequence. The lower bounding discontinuity is either an erosion surface or an older constructional geomorphic surface.

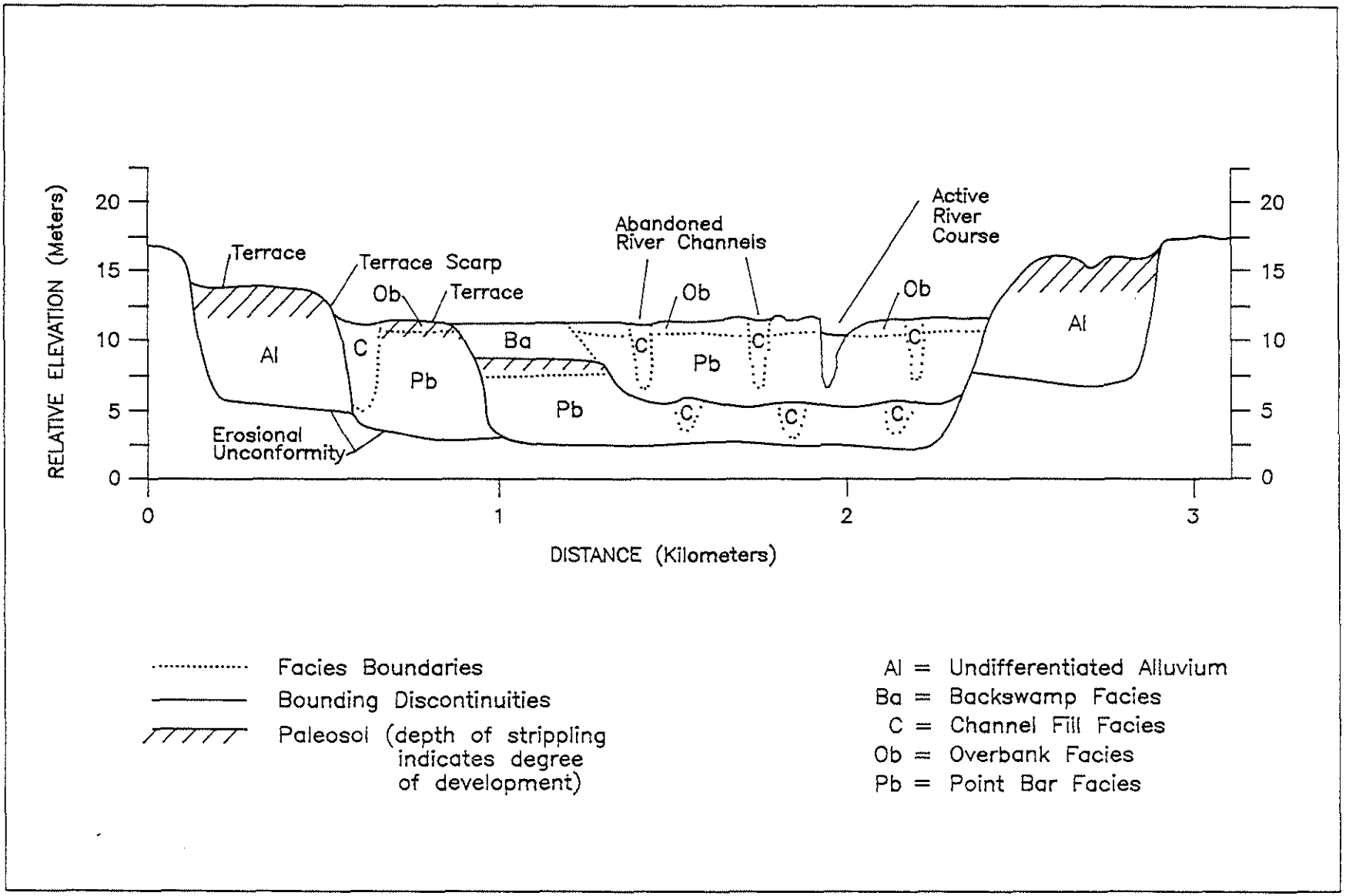


Figure 2. Hypothetical alloformations associated with fluvial terraces and meander belts, (From Heinrich, n-d.)

Typically, the deltaic sequence consists of a basal transgressive sheet sand, a middle unit of fine-grained progradational sediments, and an upper unit of aggradational natural levee and marsh sediments (Figure 3). The marsh and natural levee deposits form a delta plain which represents the upper bounding surface of the delta complex and alloformation.

If subsidence and sea level rise submerge the delta plain, the landward migration of the shoreline, called a "transgression," will destroy the delta plain and most, if not all, of the aggradation deposits that form it. This process occurs in a series of steps documented and clearly illustrated by Penland et al. (1985). As the transgression occurs, shoreface erosion deeply erodes the upper part of a deltaic complex, forming the relatively flat erosional surface called a "ravinement surface." The eroded deltaic and archeological deposits will be winnowed and redeposited by shoreface and shallow marine processes to form a sheet sand or shelf sand shoal (Penland et al. 1985, 1989).

Allostratigraphy and Archeology

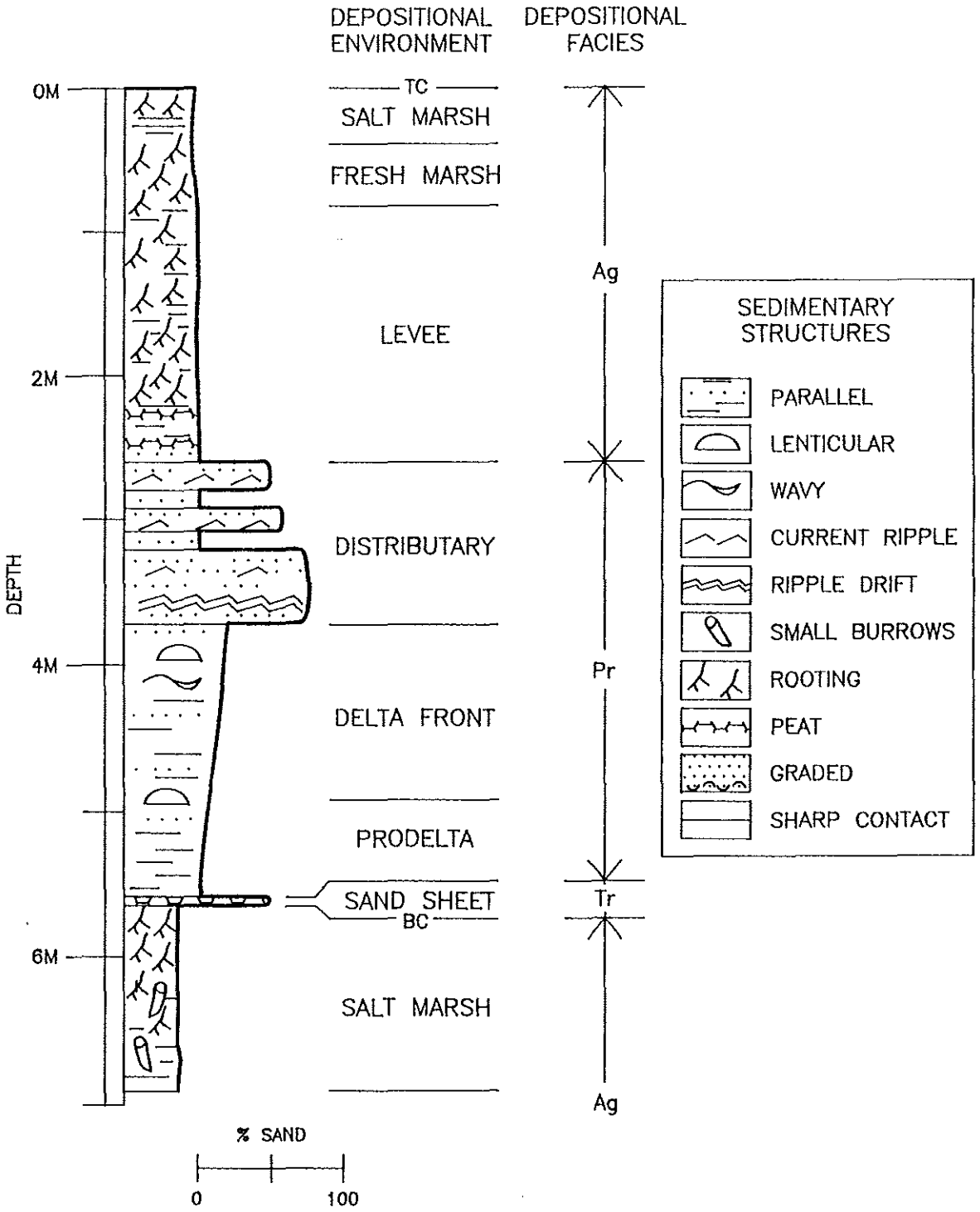
Allostratigraphic units, both alloformation and complex, are useful stratigraphic classifications that can be used to understand the archeology of the coastal zone. Both of these stratigraphic units can define a mappable, genetic sequence of sediments within what otherwise appears as heterogeneous fluvial and deltaic deposits. Unlike simple terrace mapping, allostratigraphic units formally tie geomorphic surfaces to the three dimensional sedimentary deposits associated with them. Furthermore, allostratigraphic units possess sedimentological and temporal properties that can be used to predict the general distribution and age of archeological deposits and to reconstruct paleoenvironments within the coastal zone. For geoarcheological research, allostratigraphic units possess five important properties (Autin 1989; Autin, Burns et al. 1990; Autin, Snead et al. 1990).

First, the sediments within an allostratigraphic unit accumulate only over a restricted period of time. As summarized in Autin, Burns et al. (1990), the Mississippi River meander belt and delta complexes were active for specific periods of time (Frazier 1967:Fig. 12; Saucier 1974:Fig. 3). As discussed in Chapter V, the period during which a complex is active is a primary factor in determining the age and cultural affiliation of the archeological deposits present on its surface, as well as those that are buried within it. In addition, educated guesses can be made about the age and cultural affiliations of archeological deposits that would have been destroyed by the formation of a complex. However, while the relative chronology of the meander belt complexes is well-known, the absolute dates are still in need of revision (Saucier 1987).
opinion is divided as to whether the

Second, an allostratigraphic unit consists of a well-defined sedimentary sequence deposited by a common set of fluvial or deltaic processes. For example, the deltaic complexes are composed of an orderly succession of depositional environments consisting of a basal unit of transgressive marine sediments; a middle unit of progradational prodelta, delta front, and distributary deposits; and, an upper unit of aggradational natural levee and marsh sediments (Coleman 1982; Penland et al. 1989) (Figure 3). The meander belt complexes will consist internally of variations of the upward-fining, meandering river depositional sequence (Walker 1984).

Third, the archeological deposits occur at predictable horizons within allostratigraphic units associated with delta plains, meander belts, or fluvial terraces. For example, prehistoric archeological deposits will occur only on the delta plain and within the aggradational sediments of a delta complex, as discussed in Chapter V. Similarly, prehistoric archeological deposits within a meander belt complex will be restricted to its surface and the overbank sediments that compose it.

There are two final advantages of using allostratigraphic units. First, each allostratigraphic unit reflects the influence of a specific set of environmental conditions such as fluvial regime or sea level.



Ag = AGGRADATIONAL FACIES
Pr = PROGRADATIONAL FACIES
Tr = TRANSGRESSIVE FACIES
TC = TOP OF COMPLEX (DELTA PLAIN)
BC = BASE OF COMPLEX (RAVINEMENT SURFACE)

Figure 3. Shoal-water delta depositional sequence characteristics of deltaic alloformations with a lower slope and surface elevation than those of the coast-parallel terraces. Modified from Penland (1990)

Second, the criteria for formal recognition and definition of allostratigraphic units already have been established.

Pleistocene Epoch

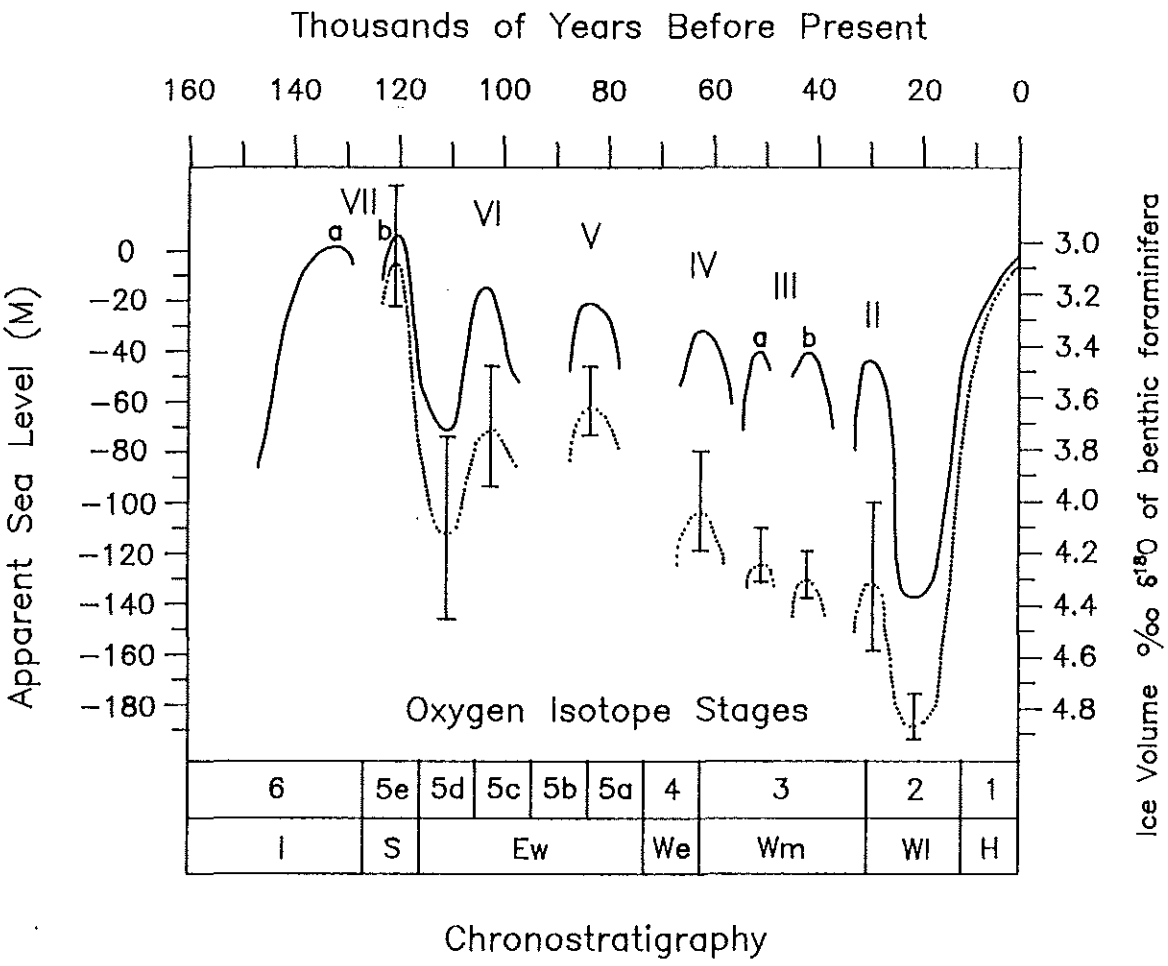
During the Late Pleistocene stage, 132,000 to 10,000 years ago, the accumulation and dissolution of continental ice sheets caused eustatic sea level to fluctuate generally between 20 to 70 m below present sea level in 20,000 year cycles (Figure 4). As a result, the shoreline migrated north and south across the Louisiana Coastal Zone and the Continental Shelf. The maximum high stands of sea level occurred at about 120,000 year intervals during interglacial periods such as the Holocene Epoch and the early Sangamonian stage. The Sangamonian high stand of sea level reached an elevation of six to seven m above present sea level around 120,000 years ago during Oxygen Isotope Stage 5E. At that time, it formed the Houston Barrier Island Chain of the Ingleside Strandline in southwestern Louisiana (Autin, Burns et al. 1990; Moore 1982; Suter et al. 1987).

Both Moore (1982) and Suter et al. (1987) clearly demonstrate that the Late Pleistocene sea level curve used by Gagliano et al. (1982:3), Stright (1990:456), and Jeter and Williams (1989:10) is oversimplified (Figures 4 and 5). This sea level curve fails to show the true number and complexity of sea level fluctuations that occurred during the Late Pleistocene stage. Also, Moore (1982) and Suter et al. (1987) demonstrate that sea level during High Sea Stand II peaked well below modern sea level, as indicated by Curve A of Gagliano et al. (1982:3). High Sea Stand II clearly failed to peak at or above modern sea level as shown by Stright (1990:456) and curve B of Gagliano et al. (1982:3). Finally, many of the relict shore lines indicated by the sea level curve of Gagliano et al. (1982:3) are very likely nonexistent as will be discussed later (Figures 4 and 5).

Late Pleistocene Stage

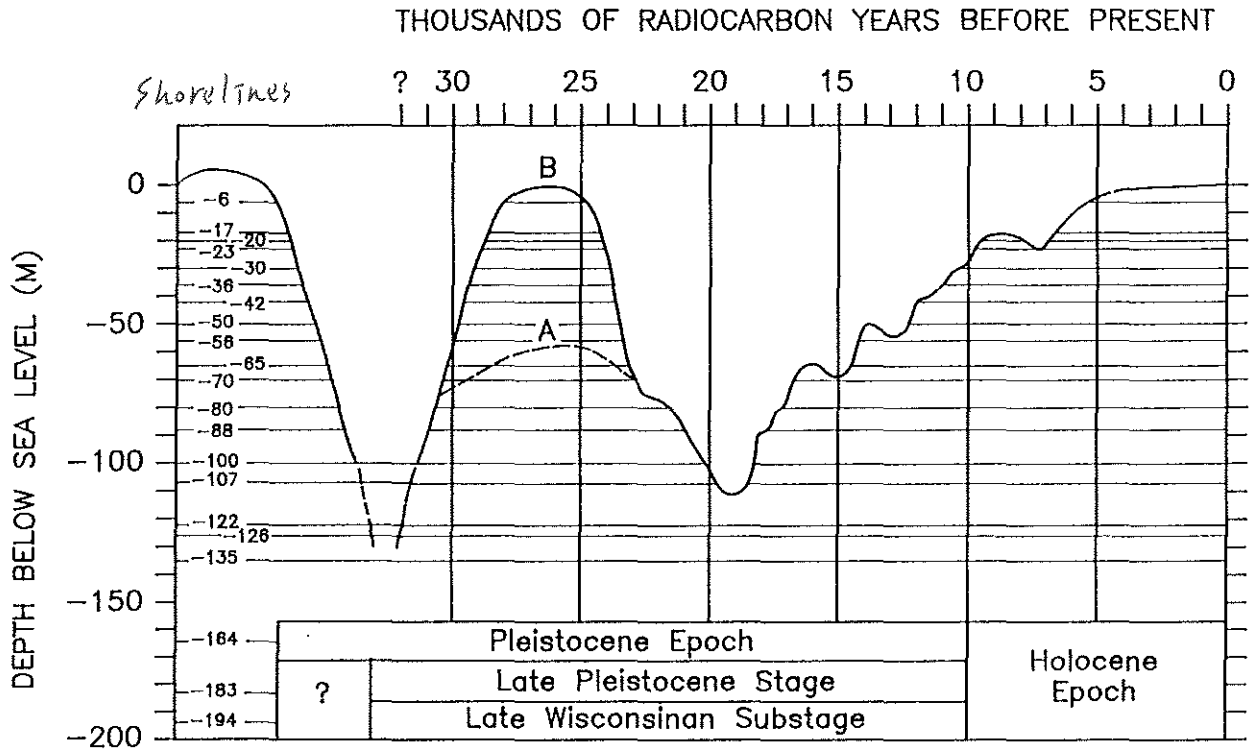
During the Late Pleistocene stage, the cyclic deposition of sedimentary sequences caused by the six to seven glacio-eustatic fluctuations of sea level formed the Prairie Terrace and the upper part of the modern Louisiana Continental Shelf. The fall in sea level resulted in the expansion of the coastal plain onto the modern Continental Shelf, and in the deposition of thin, laterally extensive deposits of shoal-water deltas and, eventually, thick fluvial deposits on the continental shelf. At maximum lowstand, the dropping of sea level below the shelf edge caused entrenchment of the shelf by fluvial systems, subaerial exposure of the shelf, and deposition of thick shelf-margin deltas at the shelf edge (Figure 6) (Fisk and McFarlan 1959; Suter 1986; Suter et al. 1987; Suter and Berryhill 1985).

When sea level rose, the ensuing transgression submerged, eroded, reworked, and redistributed fluvial and deltaic deposits as broad sand sheets and shoals. Eventually, rising sea levels submerged the surface of the continental shelf and trapped terrigenous sediments within the flooded estuaries. The resulting low influx of terrigenous sediments allowed for the shelf-wide accumulation of muds rich in biogenic carbonate and the contemporaneous diagenesis of these sediments into a condensed zone. As the rise in sea level ceased or slowed, fluvial systems, delivering an abundant supply of sediment to the coast, then built deltaic complexes that prograded seaward onto the shelf (Figure 6) (Coleman and Roberts 1988; Frazier 1967, 1974; Roberts 1987). As a result, the sediments that accumulated during the Late Pleistocene formed a coastal zone and adjacent continental shelf underlain by multiple cyclic sequences of fluvial, deltaic, estuarine, and marine sediments separated either by exposure surfaces, erosional unconformities, or condensed intervals (Coleman and Roberts 1988; Suter et al. 1987).



NOTE: I = Illinoian Stage, S = Sanganmonian Stage, Ew = Eowisconsinan Substage, We = Early Wisconsinan Substage, Wm = Middle Wisconsinan Substage, Wl = Late Wisconsinan Substage, and H = Holocene Epoch as defined by Sibrava et al. (1986). The Roman numerals associated with the high stands of sea level represent a reef complex from which each high stand was defined by Moore (1982).

Figure 4. Glacio-eustatic sea level record (solid line) and composite oxygen isotope record of deep sea benthoric foraminifera (dashed line) of the past 140,000 years. The latter is an indicator of the ice volume of continental glaciers. Modified from Williams (1984:85).



Note:

This curve fails to indicate high sea level stands I, II, IV, V, and VI. It does correctly indicate the age of high sea level stand III as given in Figure 4.

Figure 5. Late Quaternary sea level and shorelines. According to Gagliano et al. (1982:3) and Jeter and Williams (1990:11) relative to chronostratigraphy of Sibrava et al. (1986).

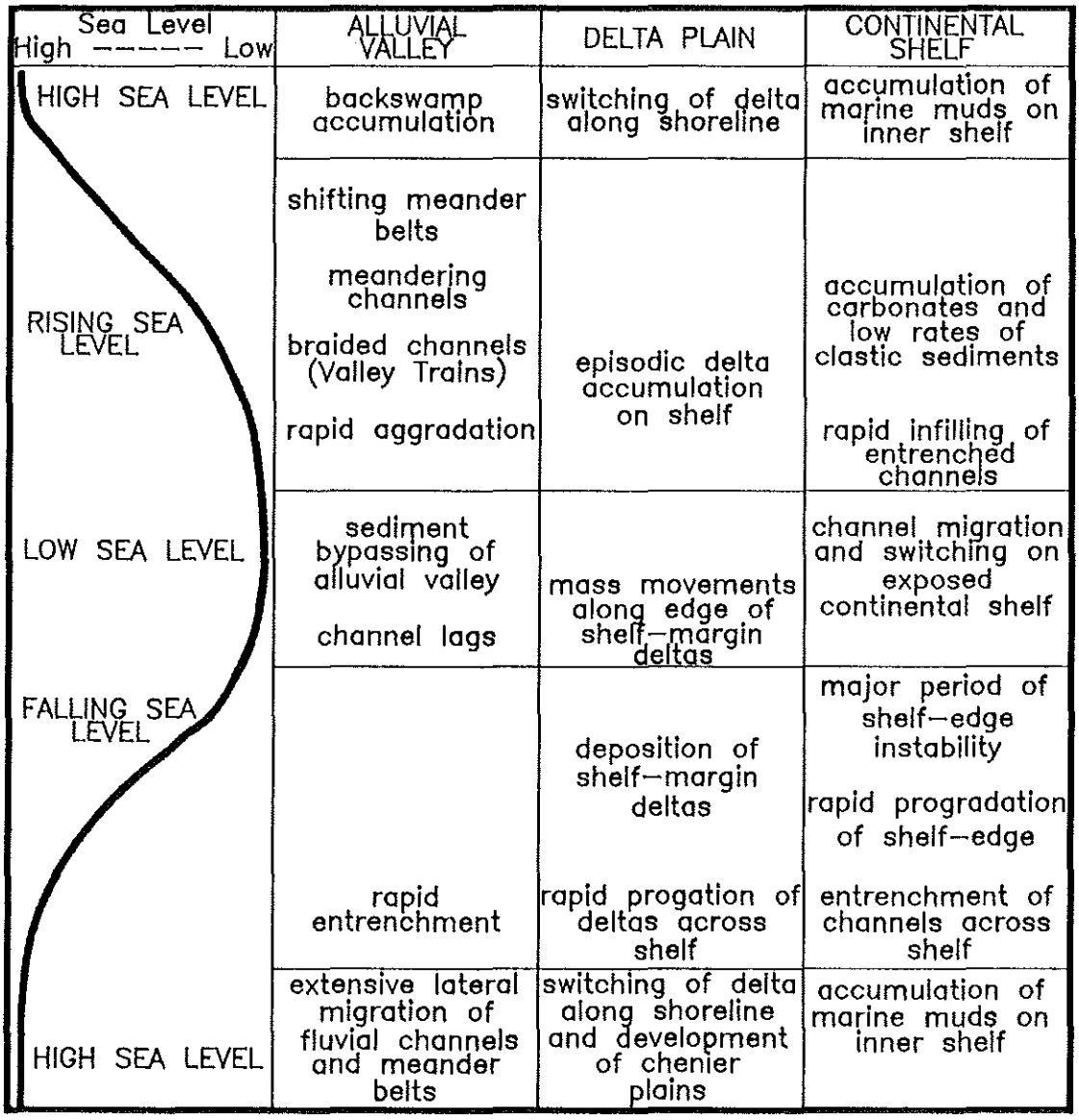

Sea Level
High ----- Low
HIGH SEA LEVEL
RISING SEA LEVEL
LOW SEA LEVEL
FALLING SEA LEVEL
HIGH SEA LEVEL
ALLUVIAL VALLEY
DELTA PLAIN
CONTINENTAL SHELF
backswamp accumulation
switching of delta along shoreline
accumulation of marine muds on inner shelf
shifting meander belts
meandering channels
braided channels (Valley Trains)
rapid aggradation
episodic delta accumulation on shelf
accumulation of carbonates and low rates of clastic sediments
rapid infilling of entrenched channels
sediment bypassing of alluvial valley
channel lags
mass movements along edge of shelf-margin deltas
channel migration and switching on exposed continental shelf
deposition of shelf-margin deltas
major period of shelf-edge instability
rapid progradation of shelf-edge
rapid entrenchment
rapid progation of deltas across shelf
entrenchment of channels across shelf
extensive lateral migration of fluvial channels and meander belts
switching of delta along shoreline and development of chenier plains
accumulation of marine muds on inner shelf

Figure 6. Diagram showing the major processes operating within the Louisiana Coastal Zone and adjacent continental shelf during a sea level cycle. Modified from Coleman and Roberts (1988:Figure 32) and Autin et al. (1990:Table 1).

Late Wisconsinan Substage

About 21,000 years ago, at the start of the Late Wisconsinan substage, relative sea level was dropping from the highest Middle Wisconsinan high stand of 20 m below present sea level, to its maximum Late Pleistocene low stand of about 120 m below present sea level (Bloom 1983:215-218; Suter et al. 1987:216-217) (Figure 4). In response, the shoreline moved 40 to 190 km south of the modern shoreline, exposing large areas of the continental shelf to subaerial weathering. Within the Louisiana Coastal Zone, the Mississippi River and its tributaries responded by partially reentrenching the Mississippi Valley by 25 to 30 m. During this lowstand, the Mississippi River and other coastal fluvial systems flowed within shallow valleys across the Louisiana Continental Shelf to shelf-margin deltas located along the edge of the Continental Shelf (Saucier 1981:10-11, 1987; Suter and Berryhill 1985).

Contrary to ~~findings of both Coastal Environments, Inc. (1977:96) and~~ Jeter and Williams (1989:11), the Mississippi Trough was not an alluvial valley by which the Mississippi River directly discharged onto the continental slope of the Gulf of Mexico during the Late Wisconsinan lowstand of sea level. Rather, the Mississippi Trough was a submarine canyon formed by large-scale retrogressive slumping initiated by shelf-margin delta deposition and enlarged by turbidity currents during the Middle Wisconsinan substage, sometime between 58,000 to 30,000 years B.P. The Mississippi Trough finally was filled by the Mississippi River between 18,000 to 10,000 years B.P., with sediment transported onto the Continental Shelf (Coleman et al. 1983:130-136; Eumont 1988:64-65).

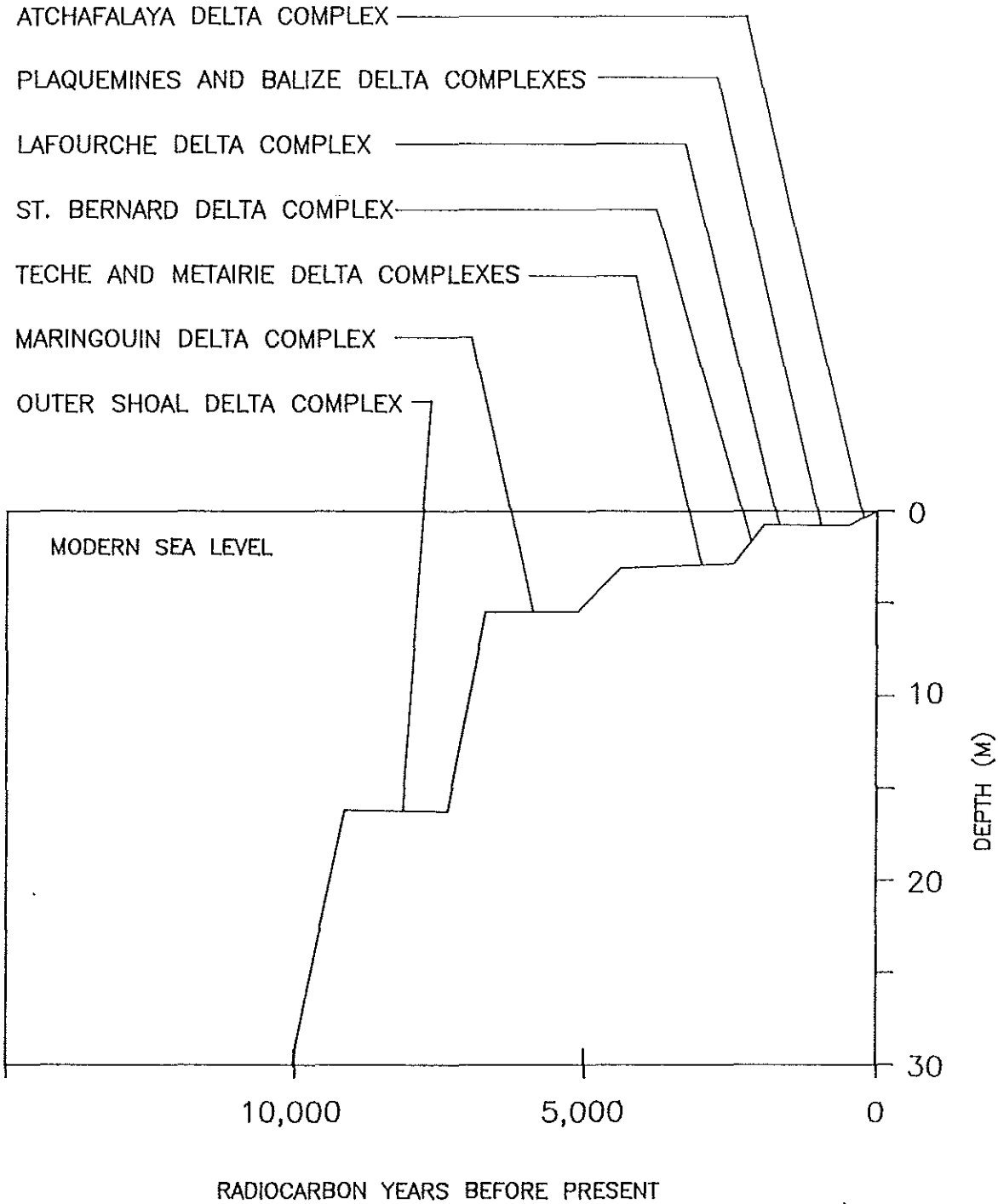
During the latter part of the Late Wisconsinan substage, relative sea level rose episodically from approximately 120 m below sea level to 30 m below sea level by 10,000 years B.P. A wide, deeply cut, erosional terrace along the edge of the outer continental shelf records one stillstand of sea level about 90 to 80 m below modern sea level during the Late Wisconsinan substage (Frazier 1974; Suter et al. 1987:210-214).

Holocene Epoch

During the Holocene Epoch, approximately 10,000 years ago to present, sea level rose from around 30 m below present levels, to current levels (Figure 7). Excluding three major stillstands, the average rate of eustatic sea level rise within the Gulf of Mexico was about eight mm per year from 10,500 to 6400 years B.P. and less than one mm per year from 6,400 years ago to present (Coulombe and Bloom 1983). Because sea level remained stable for significant periods during at least three stillstands, the actual rates of eustatic sea level rise between these stillstands were much higher than the average rates suggest. Sea level rose faster within the region of the Mississippi delta than within other parts of the Gulf of Mexico, because the relative rate of sea level rise was influenced by both regional subsidence and by a rise in eustatic sea level (Penland et al. 1988).

The Late Wisconsinan-Holocene sea level rise modified substantially the surface of the coastal plain as it was submerged to form the modern continental shelf. The effects of transgressive erosion on aggradational fluvial deposits on the former coastal plain varied from the minor removal of overbank deposits to the complete planation of natural levees. It also eroded the surface of coast-parallel terraces that lay between fluvial systems. During stillstands of sea level, the accumulation of lagoonal, chenier, or other aggradational coastal plain deposits buried the coast-parallel terrace surfaces deep enough to have survived the impact of transgressive erosion (Nummedal and Swift 1987; Pearson et al. 1986:224-245: Penland personal communication 1989; Suter personal communication 1986).

In addition, shelf and transgressive shoreface processes reworked contemporaneous shorelines and deltas. Shoreface erosion deeply eroded the surfaces of Late Wisconsinan and Early to Middle Holocene deltas, forming extensive ravinement surfaces (Penland et al 1989; Suter et al. 1987:210-212). Shelf and



Replace with Frazier's diagram from Fisher et al. (19

Figure 7. Chronologies of delta complexes and relative sea level rise. Modified from Penland et al. (1988).

shoreface processes reworked the upper parts of many barrier islands, cheniers, and deltas into marine sheet sands and east-west oriented sand shoals (Penland and Suter 1985; Suter et al. 1985; 1987:210-214). Thus, many of the stillstands shown by Gagliano et al. (1982:3) (Figure 5) are nonexistent, because the geomorphic features from which they were deduced are marine shoals and shelf sands either unrelated to or modified from former strandline positions. However, three or four of these offshore sand ridges might be drowned strandlines (Frazier 1974:19-24; Suter et al. 1987:214).

reworked During this time, the entrenched valleys of the Mississippi, Sabine, and many other rivers were sequentially filled with fluvial, estuarine, and sometimes lagoonal sediments. Valleys filled with fluvial and estuarine sequences occur across the entire Louisiana Continental Shelf. Along three major east-west belts, these valleys also contain lagoonal deposits. Only the valley fill of the Sabine River has been studied in detail (Nelson and Bray 1970; Pearson et al. 1986; Suter et al. 1987).

Archeological Potential of the Continental Shelf

According the sedimentological studies reviewed above, Stright (1990:458-459) is overly optimistic about the degree to which archeological deposits survived the Late Wisconsinan-Holocene transgression. Those studies show that, contrary to the expectations of Stright (1990:457), Late Wisconsinan and Early to Middle Holocene delta plains have been deeply eroded. Shoreface and shelf processes have eroded the natural levees, beaches, and beach ridges on these delta plains and have destroyed the associated archeological deposits (Penland et al. 1985; Nummedal and Swift 1987; Pearson et al. 1986). These studies interpret seismic data and foundation borings to demonstrate that the alluvial plains and coast-parallel terraces of the former coastal plain have been extensively eroded by shoreface erosion. Also, recent sedimentological studies indicate that many of the sand ridges on the continental shelf are not barrier islands or cheniers, but rather marine sand bodies unrelated to former strandlines. Thus, recent studies conclude that the last marine transgression extensively modified the former coastal plain and, as a result, likely caused the widespread destruction of archeological deposits on the Louisiana Continental Shelf.

However, during the transgression, the periodic aggradation of lagoonal, chenier plain, or other coastal plain deposits may have buried the contemporaneous coastal plain prior to the Late Wisconsinan-Holocene transgression. Possibly, the thickness of these sediments was enough to have protected the coastal plain and the associated archeological deposits from shoreface erosion, although archeological deposits associated with coastal landforms, such as cheniers and barrier islands, probably were destroyed (Nummedal and Swift 1987:247-248; Stright 1990:459). At this time, data providing detailed pedological descriptions of the oxidized and overconsolidated zones found in vibracores and foundation borings, which is needed to determine the extent to which the coastal plain and the associated archeological sites may have survived transgressive erosion, is lacking.

Archeological deposits buried within the valley fills of entrenched fluvial valleys have survived transgressive erosion. Archeological deposits have been recovered from the valley fills of both the Trinity and Sabine Rivers (Pearson 1986:224-225; Stright 1990:447, 459).

Mississippi River Delta

During the Holocene Epoch, the Mississippi River constructed its associated Mississippi Delta plain as a series of delta complexes. Each delta complex consists of a cluster of deltas, or "delta lobes", associated with an individual course of the Mississippi River. This cluster of deltas resulted from the switching of the locus of deposition at the end of a specific river course. When a Mississippi River course was abandoned, the associated delta complex would also become inactive, since its source of sediment and water diminished. The new river course, in turn, would create a new delta complex at its gulfward end. If sea level remained unchanged, the active delta complex coalesced with previous delta complexes to form a shared geomorphic surface called a "delta plain" (Coleman 1982; Frazier 1967).

An individual delta or delta lobe is a cluster of even smaller loci of deposition called "subdeltas". Through breaks in natural levees, these miniature deltas build out from the seaward prograding distributary channels. Subdeltas form the majority of the subaerial delta by filling in the adjacent interdistributary bays. Although the deposits of subdeltas are thin, three to 15 m in thickness, the continuing subsidence and repeated deposition and stacking of one subdelta on top of another can result in a thick sequence of subaerial delta deposits (Coleman and Gagliano 1964).

Within a delta complex, three major lithofacies have been identified. These deposits are related to the processes of progradation, aggradation, and transgression that form and modify a delta complex as a cycle of deposition. Initially, the deposition of the progradational facies in front of a seaward building delta results in a delta platform, on which foundation the subaerial delta is built. The delta plain is built and further enlarged by the deposition of natural levee, subdelta, and organic deposits of the aggradational facies contemporaneous with the gulfward deposition of the progradational facies. With subsidence and/or abandonment of an individual delta, the deltaic plain is reworked by marine processes resulting in the formation of transgressive barrier islands and, eventually, marine shoals and shelf sands (Coleman 1982; Coleman and Gagliano 1964; Frazier 1967; Penland et al. 1985).

Obviously, the occurrence of archeological deposits will be limited to the aggradational facies. As further discussed in Chapter V, the subaerial natural levee and beach sediments in which archeological deposits occur will be limited to aggradational facies. Unfortunately, with the subsidence of the delta plain, shoreface and marine processes rework and redeposit the aggradational facies, resulting in the destruction of whatever archeological deposits they may contain (Gagliano et al. 1982; Penland et al. 1985).

Mississippi River Delta Chronology — Primary Header

The Mississippi River Delta is one of the most intensively studied delta systems in the world. A voluminous amount of data pertaining to its stratigraphy, sedimentology, and history have been published in innumerable publications of various types, which exist on file with numerous state and federal agencies. The synthesis of this data, most notably by Frazier (1967, 1974), with revisions by Autin, Burns et al. (1990) and Weinstein and Gagliano (1982), has resulted in three widely accepted chronologies for delta lobe deposition (Figure 8). All three subdivide the Mississippi River Delta into six major delta complexes: the Maringouin, Teche, St. Bernard (or Metairie and La Loutre), Lafourche, Plaquemines (or Modern), and Atchafalaya Delta Complexes. Some delta chronologies do not illustrate the Atchafalaya Delta Complex; because of its short period of activity, it is difficult to graphically portray the boundaries of this delta complex.

Initial comparisons of the delta chronologies by Frazier (1967, 1974), Autin, Burns et al. (1990), and Weinstein and Gagliano (1982) indicate that significant disagreements exist among their interpretations (Figure 8). However, careful examination of the points of disagreement clearly indicates that these differences predominantly result from different definitions of what constitutes an active delta rather than from any significant divergence of opinion on the timing of activity for a specific delta complex or delta lobe.

Only the delta chronology proposed by Penland et al. (1987) differs significantly from other chronologies with respect to the stratigraphy and age of deposition of the delta complexes. Despite the large number of publications that have been produced (e.g. Penland et al. 1987, 1988, 1989), it is difficult to evaluate both their delta chronology and their depositional model, because only a very small amount of the total data is actually presented in these publications. The little data provided suggests that disagreements with other delta chronologies stem from simple stratigraphic miscorrelations.

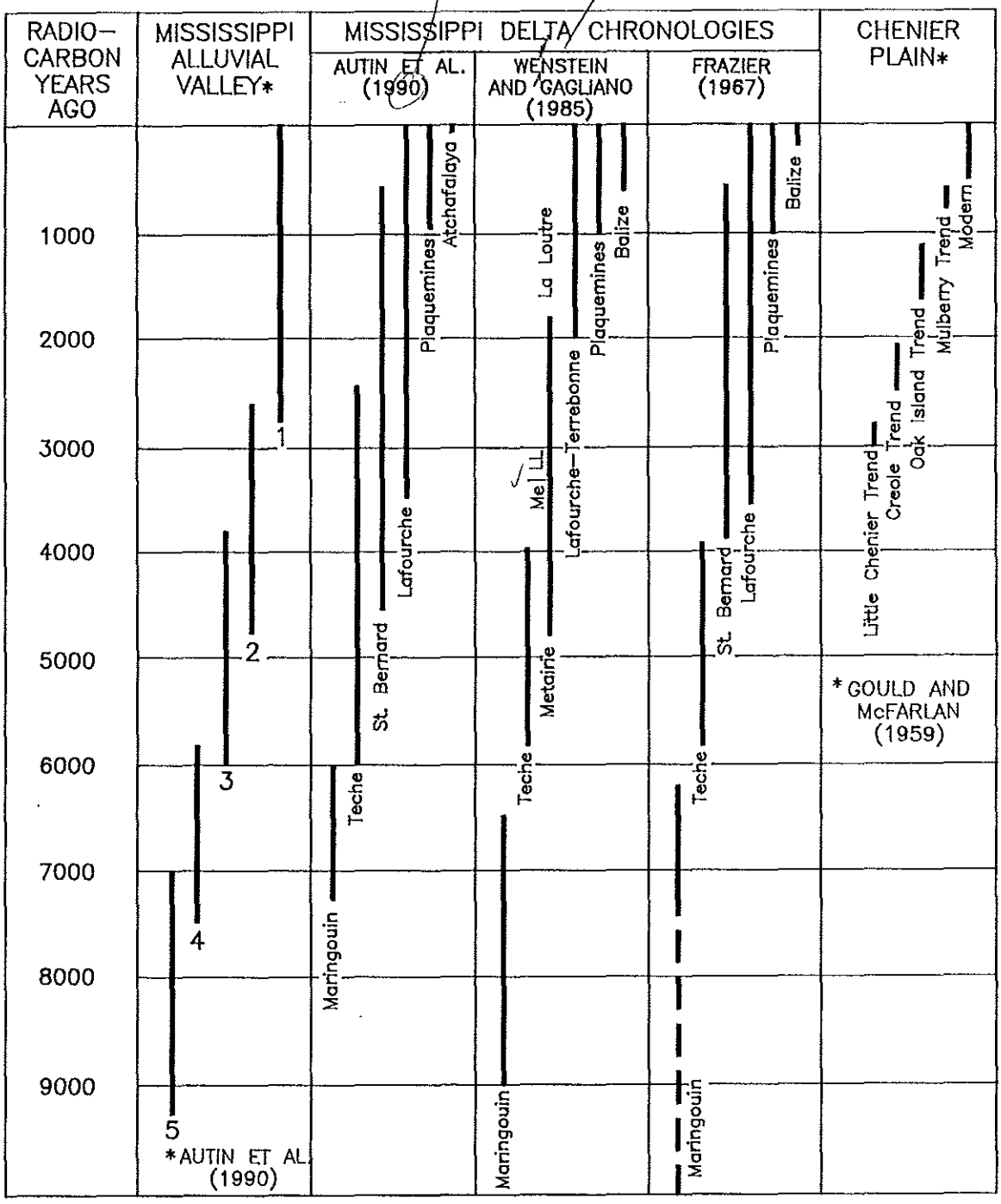


Figure 8. Chronologies of the Mississippi Alluvial Valley, Mississippi River Delta and Chenier Plain.

Unnamed Wisconsinan Delta Complexes

A cross section presented by Boyd et al. (1988) shows additional delta complexes underlying the Outer Shoal Delta Complex. Unfortunately, all that is known at this time is that these complexes underlie the Outer Shoal Delta Complex and overlie the presumably Sangamonian surface and sediments of the Prairie Complex. Contrary to the interpretations of Boyd et al. (1988), correlation of their cross section with data presented by Coleman and Roberts (1988) indicates that these complexes are probably Middle Wisconsinan in age. Therefore, these delta complexes probably predate the human occupation of the Louisiana Coastal Zone.

Outer Shoal Delta Complex

According to Penland et al. (1985), the deposition of deltaic sediments by the Mississippi River started as far back as 12,000 years B.P. Because of the rapid rate of sea level rise during the Early Holocene, only thin shoal-water deltas could have accumulated, except during a stillstand of sea level at about 15,000 to 12,000 years B.P. (Figure 7) (Frazier 1967). Also, the transgressing shoreface associated with rising sea level probably eroded these thin shoal-water deltas, and marine processes redistributed them into broad sand sheets and marine shoals such as the Sabine Bank on the western Continental Shelf (Suter et al. 1985:499-500). As a result, it is highly unlikely that the deposition of the Maringouin Delta Complex took the entire period of time stated by either Weinstein and Gagliano (1982:122) or by Frazier (1967:269) (Figures 8 and 9).

Penland et al. (1987:Figure 7) and Boyd et al. (1988:Figure 1) document another Late Pleistocene delta complex lying underneath the Maringouin Delta Complex as defined by Frazier (1967:269 and 300). Boyd et al. (1988:Figure 1) calls this delta complex the "Outer Shoal Delta Complex." It forms the "Earlier Holocene Delta Plain" of Penland et al. (1987:Figure 7), on which the Maringouin Delta Complex lies. The occurrence of this delta plain at depths of 15 to 25 m suggests that it may represent deltaic deposition around 9200-8200 years B.P. (Frazier 1974:Figure 18). Because very little has been determined or published regarding this delta complex, its actual age and relationship to sea level fluctuations are unclear.

Maringouin Delta Complex

From about 7500 to 5500 years B.P., a second stillstand occurred during the otherwise rapid rise in sea level, at a depth five to six meters below present (Figure 7). During this time, at around 7300 to 6200 years B.P., the Mississippi River built the Maringouin Delta Complex (Figures 8 and 9) (Autin, Burns et al. 1990). Frazier (1967:269) noted the presence of two stacked, depositional sequences within this delta complex.

The continued rise of sea level submerged most of the surface of the Maringouin Delta Complex, called the "Late Holocene Delta Plain" (Penland et al. 1987), by 5,000 years ago. The transgression of the shoreface across this delta plain formed a well-defined ravinement surface that was later buried by the Teche Delta Complex. Marine processes reworked the exposed portion of this delta complex into the Tiger, Ship, and Trinity Shoals (Autin, Burns et al. 1990; Frazier 1967; Smith et al. 1986:68).

An irregular line of shell ridges of uncertain origin within Terrebonne Parish may represent the Perchant Shoreline of Penland et al. (1987); this has been interpreted to be the eroded edge of the Maringouin Delta Complex by Weinstein and Gagliano (1982:122). Inland of the Perchant Shoreline, the Maringouin Delta was buried intact, as demonstrated by the presence of the relict courses of its delta lobes at shallow depths within St. Mary Parish (Smith et al. 1986:68; Van Lopik 1955:95-123). The Maringouin Delta Complex probably was fed by the Meander Belt No. 4 described by Saucier (1981:16), which occupied the western side of the Mississippi Alluvial Valley (Autin, Burns et al. 1990).

Perchant

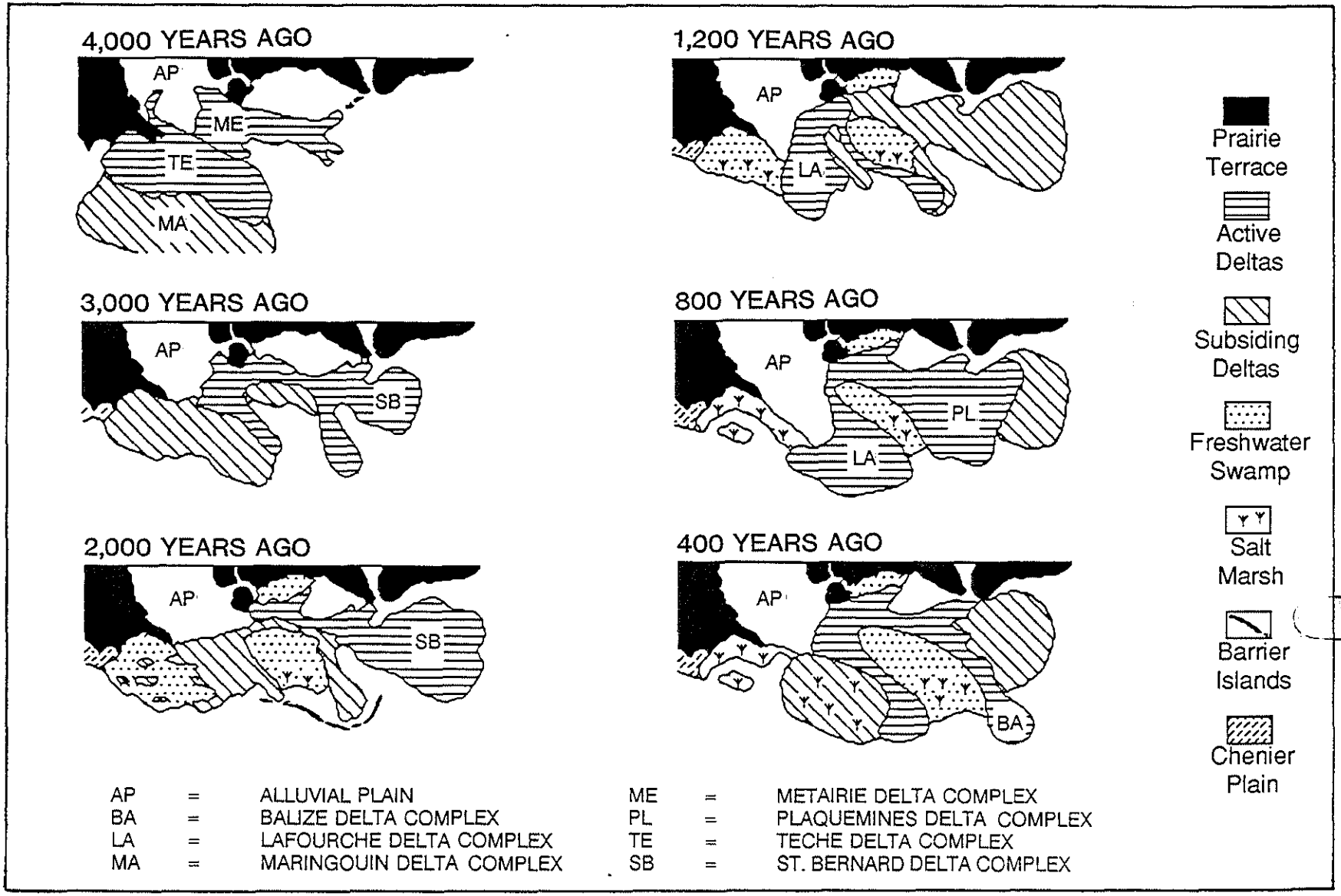


Figure 9. Paleography of the Mississippi River Delta.

At the same time, rising sea level flooded the eastern portion of the Mississippi River Alluvial Valley. This resulted in the movement of the shoreline up the Mississippi Alluvial Valley to the latitude of Baton Rouge. As a result, a brackish water embayment occupied this part of the Mississippi River Valley about 6000 to 5000 years B.P. (Saucier 1963:44-46).

Teche Delta Complex

Around 5800 years ago, the development of the Teche Delta Complex began after rising sea level had submerged most of the Maringouin Delta Complex. Between 5800 to 3900 years B.P., the Mississippi River built the Teche Delta Complex by building over the Maringouin Delta Complex (Figures 8 and 9). Within St. Mary Parish, the Teche Delta Complex buried the intact delta plain of the Maringouin Delta Complex. East of the Perchant Shoreline, the Teche Delta Complex prograded into open water over what had formerly been the Maringouin Delta Complex. The specific sequence in which the delta lobes developed, however, is controversial (Smith et al. 1986:61-64; Weinstein and Kelley 1989:33-34; Weinstein and Gagliano (1982:123).

The eastern limit of progradation for the Teche Delta Complex is also subject to debate. Smith et al. (1986:61-62) place the easternmost limit of this delta complex near Houma. In contrast, Weinstein and Gagliano (1982:123) argue that the eastern margin of the Teche Delta Complex lies 30 mi east of Houma (Figure 8). They claim that southwest trending distributaries in the Terrebonne Delta Plain, such as Bayou Du Large and Mauvais Bois, are Teche distributaries that have been reoccupied by the Lafourche Delta Complex (Weinstein and Kelley 1989:33). During its existence, drastic changes occurred within the river courses that fed the Teche Delta Complex. First, the Mississippi River switched from Meander Belt No. 4 to Meander Belt No. 3 of Saucier (1981:16). For the first thousand years, Meander Belt No. 4 supplied sediment to the Teche Delta, until it was abandoned for Meander Belt No. 3 (Autin, Burns et al. 1990). Second, an abrupt aggradation of Meander Belt No. 3 caused it to abandon and bury an older meander belt, and to form the relict river course currently occupied by Bayous Teche and Black. Finally, the Red River occupied this river course as the flow of the Mississippi River gradually shifted to the east into Meander Belt No. 2 about 3900 years B.P. As a result, the Teche Delta Complex remained active as the Red River partially discharged its flow directly into the Gulf of Mexico (Figure 9) (Goodwin, Hinks et al. 1991).

The time at which the Red River abandoned its Bayou Teche course and the Teche Delta Complex has yet to be satisfactorily determined. Autin, Burns et al. (1990:Figure 4) shows that it occurred about 2,500 years ago. However, Pearson (1986) and Weinstein and Kelley (1989:33-34) both argue on the basis of archeological data that it occurred about 1800 to 1900 years B.P.

St. Bernard (Metairie-La Loutre) Delta Complex

About 4800 years B.P., the Mississippi River began to shift its course from Meander Belt No. 3 to Meander Belt No. 2 at Marksville, which diverted much of its flow down the eastern and central part of the Mississippi Alluvial Valley (Figure 8) (Saucier 1981:16). As a result, a new delta complex, called the "early St. Bernard Delta Complex" by Frazier (1967) and the "Metairie Delta Complex" by Weinstein and Gagliano (1982:122-123) prograded into and through the New Orleans area (Figure 9). The main delta of this complex prograded about 70 km southeast of New Orleans into the Gulf of Mexico. Another small delta of this complex prograded northeast, to connect with a chain of southwest-trending barrier islands, the New Orleans Barrier Island Trend. When this delta joined with the New Orleans Barrier Island Trend, which is attached to the mouth of the Pearl River, it created a brackish water bay ancestral to Lake Pontchartrain (Otvos 1975:Figure 16; Saucier 1963:56-59).

From about 3400 to 1600 years B.P., the Metairie Delta Complex developed into the La Loutre Delta Complex of Weinstein and Gagliano (1982:123) or the St. Bernard Delta Complex of Frazier (1967). This delta complex formed two major delta lobes that prograded from the New Orleans area (Figure 9). The

larger delta, La Loutre Delta, prograded eastward to form most of St. Bernard Parish. By 3000 years B.P., this delta lobe buried the New Orleans Barrier Island Trend, creating Lake Pontchartrain. A smaller delta, the Des Familles Delta, prograded southward from the New Orleans region.

From 1800 to 600 years B.P., only the Bayou Sauvage delta of St. Bernard Delta Complex remained active (Frazier 1967:Figure 12). Weinstein and Gagliano (1982:Figure 1) considered this activity to be insufficient to consider the La Loutre (St. Bernard) Delta Complex an active delta complex for their chronology; they classify this delta complex as inactive after 1800 years B.P. In contrast, Autin, Burns et al. (1990) consider the activity of the Bayou Sauvage delta to be the waning phase of an active delta complex. As a result, they consider the St. Bernard Delta (La Loutre) Complex active until 600 years B.P. Autin et al. (1988), however, agree with Weinstein and Gagliano (1982:123) concerning the observations of Frazier (1967:Figure 12) (Figure 8). This difference, as with many differences among the delta chronologies illustrated in Figure 8, results from differences in definitions of what actually constitutes an active delta complex, rather than from differences in observed delta activity.

Lafourche Delta Complex

Between 4800 to 2000 years B.P., Bayou Lafourche slowly prograded southward from the New Orleans region. Between 4800 to 3500 years ago, Bayou Lafourche apparently formed and began to slowly prograde southward. It reached Thibodoux by the end of this period. Between 3500 to 2000 years B.P., some flow continued to be diverted down Bayou Lafourche, extending it slowly southward, and building the Terrebonne and Lafourche deltas (Weinstein and Gagliano 1982:123). The distributaries of the Terrebonne Delta probably reoccupied relict distributaries of the former Teche Delta Complex.

By 2000 years B.P., the Lafourche Delta Complex reached its peak discharge. As detailed by Weinstein and Gagliano (1982:142-144), the Lafourche Delta Complex consisted of two delta lobes between which the flow of the Mississippi River was equally divided (Figure 8). West of Timbalier Bay, the Terrebonne Delta consisted of Bayous Terrebonne, Grand Caillou, and Petit Caillou. East of Timbalier Bay, the Lafourche Delta consisted of Bayou Lafourche and its distributary system. Bayou Lafourche cut through and at times reoccupied relict courses of the Teche Delta Complex.

In addition, Little Black Bayou reoccupied parts of the course and distributaries of the Teche-Red River by 1600 years B.P. As a result, flow along the former Red and Mississippi Rivers between Houma and Morgan City had reversed. Former Teche distributaries such as Bayous Du Large and Mauvais Bos, Turtle Bayou, and the Lower Atchafalaya now functioned as distributaries of the Lafourche Delta Complex (Gould and Morgan 1962; Weinstein and Gagliano 1982:142-144).

By about 1000 years B.P., the discharge through the Lafourche Delta Complex began to wane as the discharge of the Mississippi River reoccupied the St. Bernard/La Loutre Delta Complex. Flow through the Terrebonne Delta stopped and active progradation of that delta ceased. Since then, the Terrebonne Parish region has been slowly subsiding and deteriorating. Bayou Lafourche remained an active distributary of the Mississippi River until it was artificially closed in 1904 (Weinstein and Gagliano 1982:144).

Plaquemine Delta Complex

About a thousand years B.P., the relict feeder channel of the St. Bernard (La Loutre) Delta Complex was reoccupied partially and a delta of the Plaquemines Delta Complex prograded through the interlobe basin between the Des Familles and La Loutre Deltas of the St. Bernard Delta Complex. Initially, the discharge flowed through a series of channels in this basin, such as the River aux Chenes, Belair, and Bayou Grande Cheniere. By approximately 600 years B.P., the Bayou Grande Cheniere became the modern course of the lower Mississippi River. As the shoal-water Plaquemines Delta Complex prograded to the shelf edge, the shelf-margin Balize Delta formed (Weinstein and Gagliano 1982:125, 143).

Chenier Plain Chronology

The Louisiana Chenier Plain occupies the southwestern part of the coastal zone. The Chenier Plain consists of a 200 km long, 20 to 30 km wide strip of marsh and mudflats that have aggraded up to or slightly above modern sea level along the Louisiana coast. Four sets of laterally persistent, east-west ridges of sand and shell break the marsh and mudflats into well-defined east-west strips. The ridges, ranging in elevation between 6 to 2 m, are mostly cheniers which grade laterally into beach ridges or recurved spits. In addition to mudflats and clastic ridges, large lakes occupy large portions of the Chenier Plain. Both the Calcasieu and Mermentau Rivers, along with numerous tidal channels, cut across the Chenier Plain (Gould and McFarlan 1959; Penland and Suter 1989).

The Chenier Plain is a Holocene sequence of prograding mudflats that have been intermittently reworked to form cheniers and associated beach ridges and recurved spits. When the Mississippi River discharges sediment into the Gulf of Mexico adjacent to the Chenier Plain, some of this sediment is carried westward along the shoreline, where it accumulates and aggrades the mudflats. When this sediment discharge occurs some distance from the Chenier Plain, marine processes erode and rework the mudflats to produce the chenier ridges and associated beach ridges (Gould and McFarlan 1959; Penland and Suter 1989).

Gould and McFarlan (1959) proposed that the Chenier Plain was formed by the periodic progradation of the mudflats from the edge of the Prairie Terrace. According to their model, the shoreline transgressed across the coastal plain until the modern highstand of sea level was reached about 3000 years B.P., forming a shoreline along the boundary between the Chenier Plain and the Prairie Terrace (Figure 10). They concluded that, since 3000 years B.P., the Chenier Plain has prograded from the edge of the Prairie Terrace by the periodic addition of mudflats to its southern edge. Periodic interruption of progradation resulted in the erosion and reworking of the Chenier Plain that formed each of the chenier-beach ridge trends. In Gould and McFarlan's model, each of the four chenier-beach ridge trends correlates with the abandonment of a major deltaic complex, beginning with the Teche Delta Complex (Figure 10) (Gould and McFarlan 1959).

Recently, Penland and Suter (1989) proposed that the Chenier Plain aggraded concurrently with rising sea levels. According to this model, by about 3000 years B.P., the Chenier Plain north of the innermost chenier-beach ridge trend formed. The innermost chenier-beach ridge trend, called the Little Chenier-Little Pecan Island Trend, was the northernmost shoreline of the Holocene Gulf of Mexico instead of the edge of the Prairie Terrace. Since 3000 years B.P., the southern part of the Chenier Plain periodically prograded gulfward. Periodic interruption of this progradation resulted in the erosion and reworking of the Chenier Plain that formed the other three chenier-beach ridge trends. The younger three chenier-beach ridge trends reflect changes in sediment supply resulting from the switching of delta lobes within the Lafourche Delta Complex (Figure 10).

Both models imply a different degree of preservation for archeological deposits that lie on the coastal plain buried beneath the Holocene sediments of the Chenier Plain. The model of Gould and McFarlan (1959) suggests that during the Late Wisconsinan-Holocene transgression, the landward moving shoreline scoured the entire coastal plain buried by the Chenier Plain. Presumably, the movement of this shoreline across the coastal plain scoured and deeply eroded the surface, destroying most of the archeological deposits lying on it. Archeological deposits would have survived only within the estuarine and fluvial sediments filling the valleys of the Sabine, Calcasieu, and other rivers. The model of Penland and Suter (1989) proposes that the buried strip of coastal plain between the northern edge of the Chenier Plain and the Little Chenier-Little Pecan Island Trend was buried by the vertical accretion of lagoonal and marsh sediments, and was not transgressed by a high-energy shoreline. As a result, the archeological deposits that accumulated on this surface still should be intact, although buried. Because of unresolved problems with the deltaic model of Penland et al. (1987), it is uncertain as to which of the above situations exists.

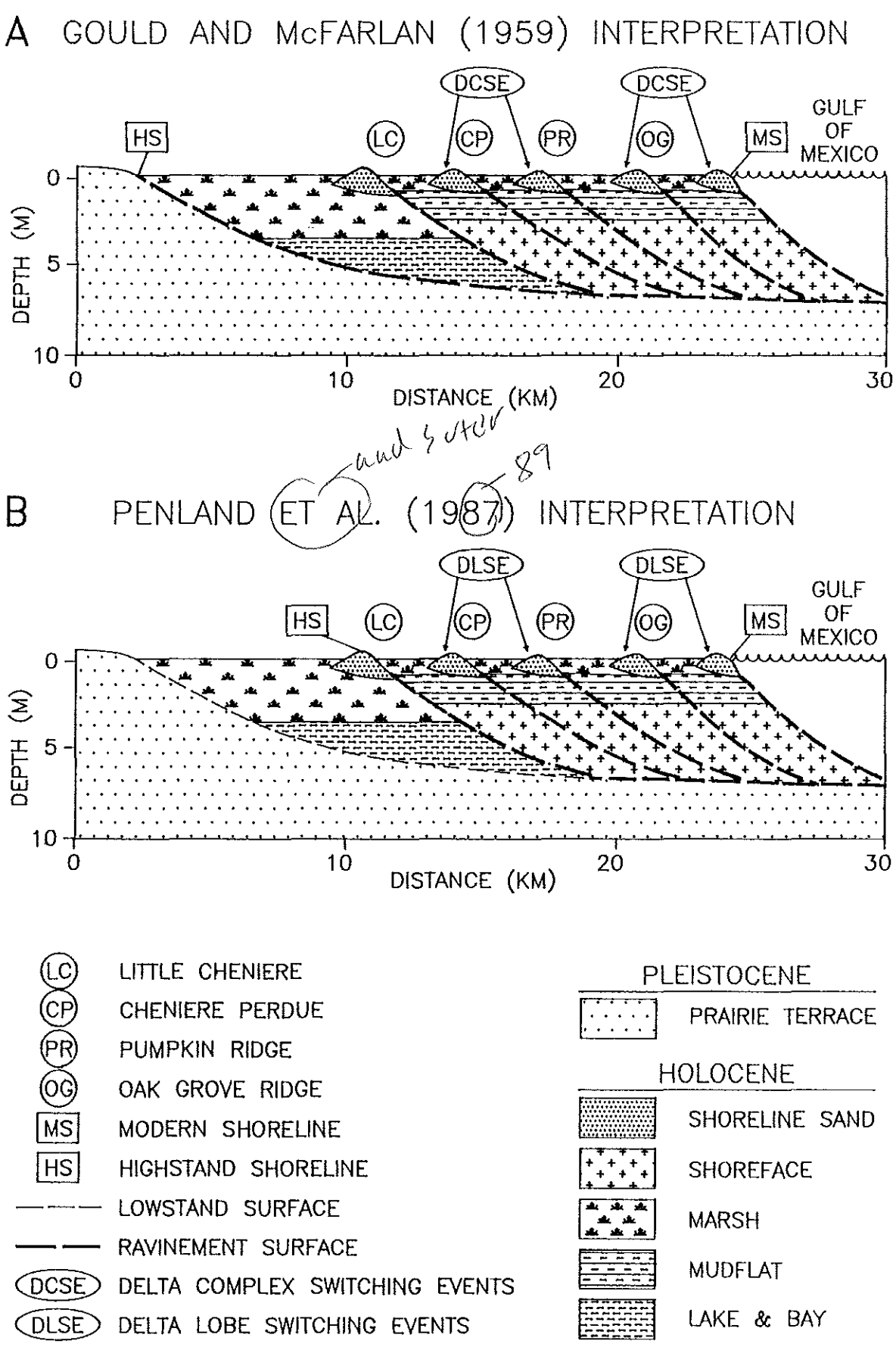


Figure 10. Interpretation of the Chenier Plain facies relationships based on the Teche shoreline.

CHAPTER IV

GEOMORPHIC REGIONS

by Paul V. Heinrich

For this report, the physiographic regions recognized within the coastal zone are subdivided into smaller units called geomorphic regions. A geomorphic region is a part of a physiographic division characterized by a geomorphically related set of landforms, such as a delta plain or meander belt. A few of these geomorphic regions, e.g. Meander Belt No. 3, consist of two or more of these geomorphic surfaces, which have intergrown or superimposed so as to form essentially a single surface. Distinguishing these surfaces would require work beyond the scope of this study. The purpose of this chapter is to describe and discuss specific geomorphologic features and processes that have influenced the distribution of archeological sites within them.

Prairie Terrace

Within the Coastal Zone, the Prairie Terrace is subdivided, for purposes of this report, into three informal geomorphic regions, the Eastern Prairie Terrace, the Lafayette Meander Belt, and the Western Prairie Terrace (Figure 1). Recent studies demonstrate that the Western and Eastern Prairie Terraces can be further subdivided into discrete alluvial plains, e.g. Autin et al. (1988:382) and Aronow (1986). Another geomorphic region within the Prairie Terrace, the Houston Barrier Island Chain, is not described by this report because it lies outside the area of examination. However, Barrilleax (1986) provides a detailed description of this geomorphic region, and Aronow (1986) discusses the relict fluvial topography associated with it.

Western Prairie Terrace

The Western Prairie Terrace (geomorphic region) forms the surface of the Prairie Complex that lies between the Sabine River alluvial valley and the Lafayette Meander Belt. To the north and outside of the coastal zone, it onlaps the older, Sangamonian Age, Houston Barrier Island chain of the Ingleside Strandline. To the south, this surface is overlapped and lies buried beneath Holocene marsh and swamp deposits that form the Chenier Plain (Aronow 1986:5; Miller 1986).

Within the coastal zone, the Western Prairie Terrace exhibits two different groups of relict fluvial landforms. East of Bayou Choupique, its surface consists of relict fluvial and deltaic landforms of Red River origin. West of Bayou Choupique, these plains exhibit relict depositional topography created by ancient meander belts and deltas of the Sabine River (Fisk 1948:11, Plate 2; Bernard et al. 1962; Aronow 1986:5-6).

The relict fluvial landforms exhibited by the Red River plain consist of the relict channels, levees, and backswamps of large meandering streams (Figure 1). Their preservation ranges from well-defined meander loops, as found about 3.2 km south of the former Lake Charles Air Force Base within Lake Charles, to fragmentary channels, and detached, discontinuous meander loops. Typically, the formation of pimple mounds and agricultural, urban, and industrial development has obscured these courses. Associated with the relict river courses and meander loops are subtle relict natural levees, crevasses, and backswamps. The natural levees rise only about 1.5 m above the interchannel lowlands, which formerly were backswamps (Fisk 1948:11, Plate 2; Bernard et al. 1962:Figure 1; Aronow 1986:6-7).

Within the Red River plain, the fluvial topography created by the Red River imparts a northeast-southwest grain to its topography, which is reflected in the location of minor drainages. These drainages, which consist of small, intermittent streams and ditches, occupy relict Red River channels and bayous that lie within its former backswamps (Aronow 1986:6-7). Similar drainage relationships have been

documented by Van Siclen (1985) and can be observed in Aronow (1971:Figures 20 and 21) for the Beaumont Terrace of Southeast Texas.

The relict fluvial landforms created by the Sabine River consist of the traces of many poorly preserved, very obscure, and fragmentary meander loops. These abandoned Sabine River courses are better defined and more continuous near Stark, Louisiana. Within the Sabine River Plain, the relict fluvial landforms give its topography a northwest-southeast grain (Aronow 1986:6-7).

Proven relict coastal landforms are lacking in the exposed southern edge of Western Prairie Terrace. However, east-west trending ridges of undetermined origin, three to five m high, extend 20 to 30 km east and west of the north end of Lake Calcasieu. Aronow (1986:7) and Saucier (1977:16) have noted that these ridges could be either beach ridges, wave-modified levee or meander ridges, or unmodified fluvial levee or meander ridges.

The stratigraphy and depositional facies of the sediments that underlie the Western Prairie Terrace are very poorly understood. The surficial sediments beneath the relict fluvial topography are of fluvial origin. However, brackish and marine faunas described by Bernard (1940) are indicative of shallow marine, lagoonal, and estuarine sediments occurring within the sediments of this part of the Prairie Complex. The distribution, stratigraphy, and age of the sediments of the Prairie Complex have not been determined, although some speculative models, e.g. Otvos (1975), have been proposed (Autin, Burns et al. 1990).

The age of the Western Prairie Terrace is a subject of controversy, and has not been determined with any confidence (Aronow 1986:8). The work of Coleman and Roberts (1988:102-104) and the lack of relict coastal landforms suggest only that the Western Prairie Terrace formed during a high sea level stand or stands at a level lower than present. Also, the Western Prairie Terrace postdates the Houston Barrier Island Chain and predates the Lafayette Meander Belt (Autin, Burns et al. 1990; Van Lopik 1955:Figure 17). From these relationships, it can be speculated that the fluvial plains formed in response to a high sea level stand or stands at either 80,000 (Oxygen Isotope Stage 5C), or 100,000 B.P. (Oxygen Isotope Stage 5A) or both (Figure 4).

Regardless of its age, it is certain that Western Prairie Terrace predates the human occupation of the coastal zone. As a result, in situ archeological deposits will be restricted to the surface of this terrace. Buried archeological deposits will occur only within the Holocene eolian, colluvial, or overbank sediments which have accumulated upon it. However, buried archeological deposits can be expected to be present within the Holocene deposits of the many bayous, streams, and small rivers that drain this surface.

Lafayette Meander Belt

The Lafayette Meander Belt (geomorphic region) consists of a well-preserved, Late Pleistocene meander belt of the Mississippi River covered by a variable thickness of Late Wisconsinan loess (Figure 1). Fragments of the Lafayette Meander Belt occur on the Prairie Terrace adjacent to the western edge of the modern Mississippi River Valley north of the coastal zone. Within the coastal zone, a 30 km long and nine km wide segment of the Lafayette Meander Belt extends from Lafayette across Lafayette, St. Martin, and Iberia Parishes to Esther, Louisiana. At Esther, Louisiana, and westward along the southern edge of the Prairie Terrace into Vermilion Parish, the Lafayette Meander Belt disappears beneath Holocene swamp and marsh deposits that form part of the Chenier Plain (Fisk 1948:11, Plate 2; Gould and Morgan 1962:Figure 13). South and southeast of Jefferson Island and within Iberia Parish, a featureless and flat clay plain of uncertain age and origin forms the surface of the Prairie Terrace between the Lafayette Meander Belt and the adjacent Holocene delta and Chenier Plains (Autin 1984:295-297).

The Lafayette Meander Belt exhibits a distinct, relict fluvial depositional topography. The meander belt topography consists of well-developed and preserved natural levees, point bars, crevasses, and

abandoned channel segments. Also, a river course of the scale and wavelength of the Mississippi River is found covered by two to eight m of Peoria Loess (Miller et al. 1985; Callihan 1988; Saxton 1986; Rouly 1989). However, contrary to Rouly (1989) and Callihan (1988), inspection of available aerial photography, soil surveys, and topographic maps, and a review of previous studies found evidence lacking for relict delta plain topography within the Lafayette Meander Belt. In addition, the complexity, width, and number of meander loop cut-offs indicates that this complex consists entirely of a fragment of an alluvial valley that was active for over a thousand years (Fisk 1948:Plate 2; Kolb and Van Lopik 1966; Fisher and McGowen 1967; Saucier and Snead 1990).

Contrary to Jeter and Williams (1989:11) and research conducted by Coastal Environments, Inc. (1977:97,98, 314) the Lafayette Meander Belt neither fed their "Sabine Bank", "Tiger Shoal", and "unnamed delta lobes" on the continental shelf, nor did it extend as far west as Mud Lake in Cameron Parish. The seismic data used by, and the work of Suter et al. (1987) and Suter (1986), clearly indicate that the Sabine Bank Delta Lobe and the Lafayette Delta Complex to which it belongs are both nonexistent. Frazier (1967) found that Tiger Shoal was associated directly with the Maringouin Delta Complex. Therefore, their Tiger Shoal Delta Lobe is also nonexistent. In addition, Penland and Suter (1989:248-249) clearly demonstrate that Mud Lake is a relict fluvial feature unrelated to the Lafayette Meander Belt.

At this time, formal stratigraphic subdivisions of the sediments that lie beneath the loess on the Lafayette Meander Belt are lacking. Work by Callihan (1988), Saxton (1986), and Rouly (1989) indicates only that fluvial deposits underlie the Lafayette Meander Belt. However, insufficient data exist to allow for the stratification of sediments beneath the Lafayette Meander Belt.

The Mississippi River created this part of the Prairie Complex apparently during the Middle Wisconsinan Stage. Geologically, the Lafayette Meander Belt is older than the Peoria Loess that covers it, and younger than the Sicily Island Loess that covers the Intermediate Terrace to north. Autin et al. (1988) and Alford et al. (1983, 1985) give evidence for correlative Middle or early Late Wisconsinan fluvial sequences within the Red River Valley and Baton Rouge area (Autin, Burns et al. 1990). If so, then the Lafayette Meander Belt was probably graded down to a high stand of sea level lower than present during either the Middle Wisconsinan (high sea stand III of Figure 4) or early part of the Late Wisconsinan (high sea stand II of Figure 4).

Regardless of its age, the Lafayette Meander Belt definitely predates the human occupation of the coastal zone. As a result, in situ archeological deposits will be restricted to the surface of the loess that covers its meander belt. Buried archeological deposits can occur only within the Holocene sediments which accumulated upon it and which comprise the valley fill of the many bayous, streams, and small rivers that cross its surface. This is especially true of the entrenched course of the Vermilion River. Furthermore, the abandoned channels of the Lafayette Meander Belt, now occupied by "oxbow bogs," might contain long, valuable records of paleoenvironmental changes within Southwestern Louisiana (A. Todd Davidson, personal communication 1986). Esther, Louisiana lies within an excellent example of such an "oxbow bog."

Trappey? Mastodon -

Eastern Prairie Terrace

East of the Mississippi River, the Prairie Terrace forms a narrow coast-parallel terrace from which fluvial terraces extend northward along both extra and intrabasinal drainages. The Eastern Prairie Terrace consists of coalesced alluvial plains exhibiting constructional topography that has been degraded to varying degrees (Mossa and Autin 1989; Snead and McCollum 1984). Because of limited space, the excellent review by Mossa and Autin (1989:1-18) of previous research concerning the mapping, stratigraphy, and origin of the Eastern Prairie Terrace is not repeated.

Within the Florida Parishes, the nature of the southern edge of the Eastern Prairie Terrace is highly variable. Within Acension Parish and southwestern Livingston Parish, the Holocene marsh, swamp, and

alluvial deposits overlap the Prairie Terrace. From southeastern Livingston Parish north to the Pearl River, the boundary of the Eastern Prairie Terrace consists of a discontinuous coast-parallel escarpment. Work by Saucier (1963:12-16) has documented displacement and other physical characteristics which demonstrate that fault scarps form most of this terrace boundary (Snead and McCulloh 1984; Mossa and Autin 1989:59-60).

Alluvial Plains

The Prairie Terrace consists of the coalesced Late Pleistocene alluvial plains of the rivers that currently cross it. For example, Autin et al. (1988:382) mapped an ancestral Mississippi River meander belt that occupied western and southern East Baton Rouge Parish. Large-scale meander scars on meander ridges composed of well-drained ~~and granular~~ soils define the extent of this meander belt. Gagliano et al. (1979) mapped abandoned river courses and channels of the Late Pleistocene Pearl River on the Prairie Terrace on either side of the modern alluvial valley of the Pearl River. However, detailed mapping of the remaining alluvial plains that form the remainder of the Prairie Terrace has not yet been published.

Ongoing work, demonstrates that within the Florida Parishes, as elsewhere in Louisiana, the Prairie Complex consists of at least two, and possibly more, alloformations whose boundaries are defined by regionally mappable paleosols called "geosols" (Figure 11). Both alloformations consist of alluvial deposits that accumulated in response to brief periods of rising sea level associated with multiple, closely spaced high sea stands. The lower unnamed alloformation of the Prairie Complex probably accumulated episodically during parts of Eowisconsinan/Early Wisconsinan, ~~and Middle Wisconsinan~~ high sea stands. The upper unnamed alloformation probably accumulated episodically during ~~Late~~ Middle Wisconsinan high sea stands (Whitney Autin, personal communication 1989; Autin, Burns et al. 1990).

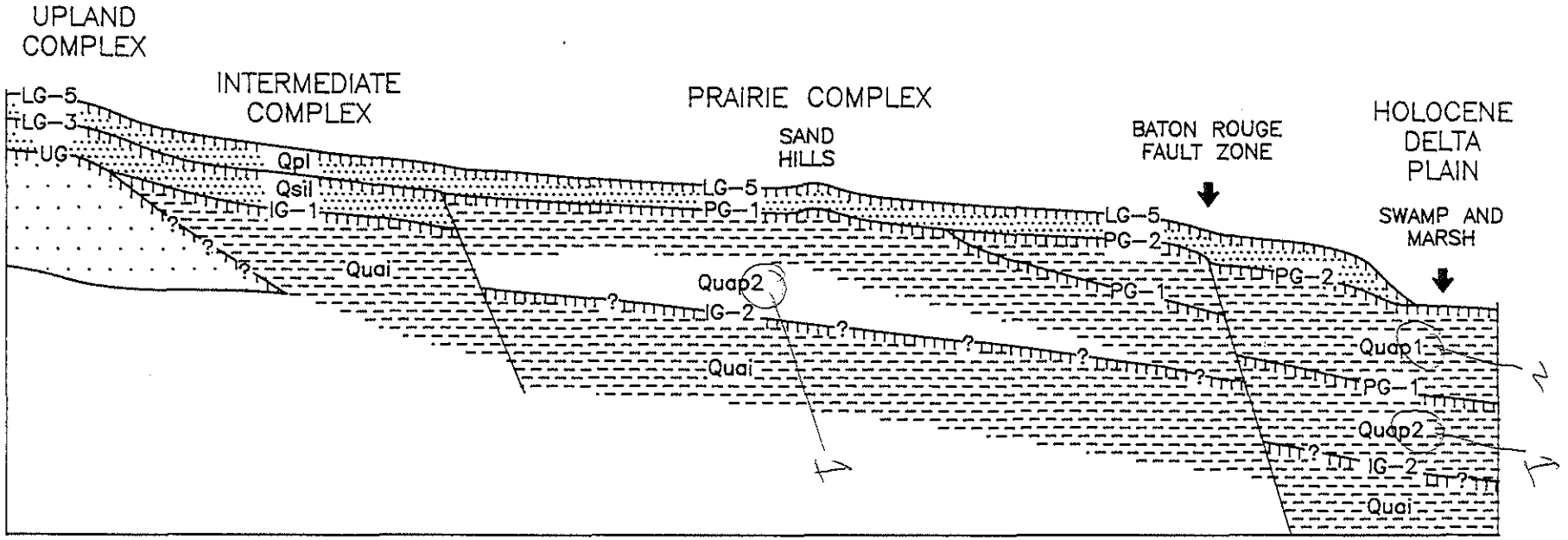
Sand Hills

Low relief sandy ridges on which archeological sites commonly occur are an ubiquitous landform found on the Prairie Terrace within the Florida Parishes. These ridges are elongate sand hills that are generally two to five m high, 50 to 300 m long, and 30 to 200 m wide. Some of these hills are as high as five to ten m, and are 600 m long. These sand hills occur within north-south trends that parallel the courses of the Amite, Comite, Tickfaw, Tangipahoa and other rivers (Otvos 1971:1754-1755; Mossa and Miller 1989:49-58).

Initially, it was proposed that these sand hills were either Middle Holocene or Late Wisconsinan eolian deposits. Gagliano (1963:110) states that the sand hills were sand dunes formed during very dry Middle Holocene climates within southeast Louisiana. Otvos (1971), on the basis of geomorphic and sedimentological criteria, suggests that these sand hills were sand dunes that formed on the Prairie Terrace during the Late Wisconsinan Substage.

Work by Mossa and Miller (1986; 1989) demonstrates that sand hills represent erosional remnants of Late Pleistocene fluvial sediments (Figure 12). They propose that as much as 10 to 20 m of ~~Late~~ Sangamonian or Eowisconsinan deposits have been removed by erosion resulting in the formation of the sand hills. However, Autin (personal communication 1989) suggests that the sand hills are point bars and similar landforms elevated by the erosion of only the upper few meters of the associated alluvial plains, as indicated by the presence of lateral persistent paleosols within subsurface sediments of the Prairie Complex (Figure 12).

The origin of the sand hills is important to archeological work within the Eastern Prairie for two reasons. First, interpretations by Mossa and Miller (1986;1989) of their origin refute interpretations by Gagliano (1963:110) and Otvos (1971) respectively for a period of very arid paleoclimate during either the Middle Holocene Stage or Late Wisconsinan Substage. Finally, their theories clearly establish the origin of



STRATIGRAPHIC UNITS

WISCONSINAN STAGE

LG–5 = UNNAMED LOESS GEOSOL #5
Qpl = PEORIA LOESS
PG–2 = UNNAMED PRAIRIE COMPLEX GEOSOL #2
Quap2 = UPPER UNNAMED PRAIRIE COMPLEX ALLOFORMATION
PG–1 = UNNAMED PRAIRIE COMPLEX GEOSOL #1
Quap1 = LOWER UNNAMED PRAIRIE COMPLEX ALLOFORMATION
LG–3 = UNNAMED LOESS GEOSOL #3
Qsil = SICILY ISLAND LOESS

SANGAMONIAN AND OLDER STAGES

IG–1 = UNNAMED INTERMEDIATE COMPLEX GEOSOL #1
IG–2 = UNNAMED INTERMEDIATE COMPLEX GEOSOL #2
Quai = UNNAMED INTERMEDIATE COMPLEX ALLOFORMATION
UG = UNNAMED UPLAND COMPLEX GEOSOL

LOESS
FINE–GRAINED ALLUVIUM
COARSE–GRAINED ALLUVIUM
COLLUVIUM AND OLDER ALLUVIUM
GEOSOLS

Figure 11. Cross section of Coast-Parallel Terraces showing stratigraphy of associated complexes. Modified from Autin et al. (1990: Figure 4).

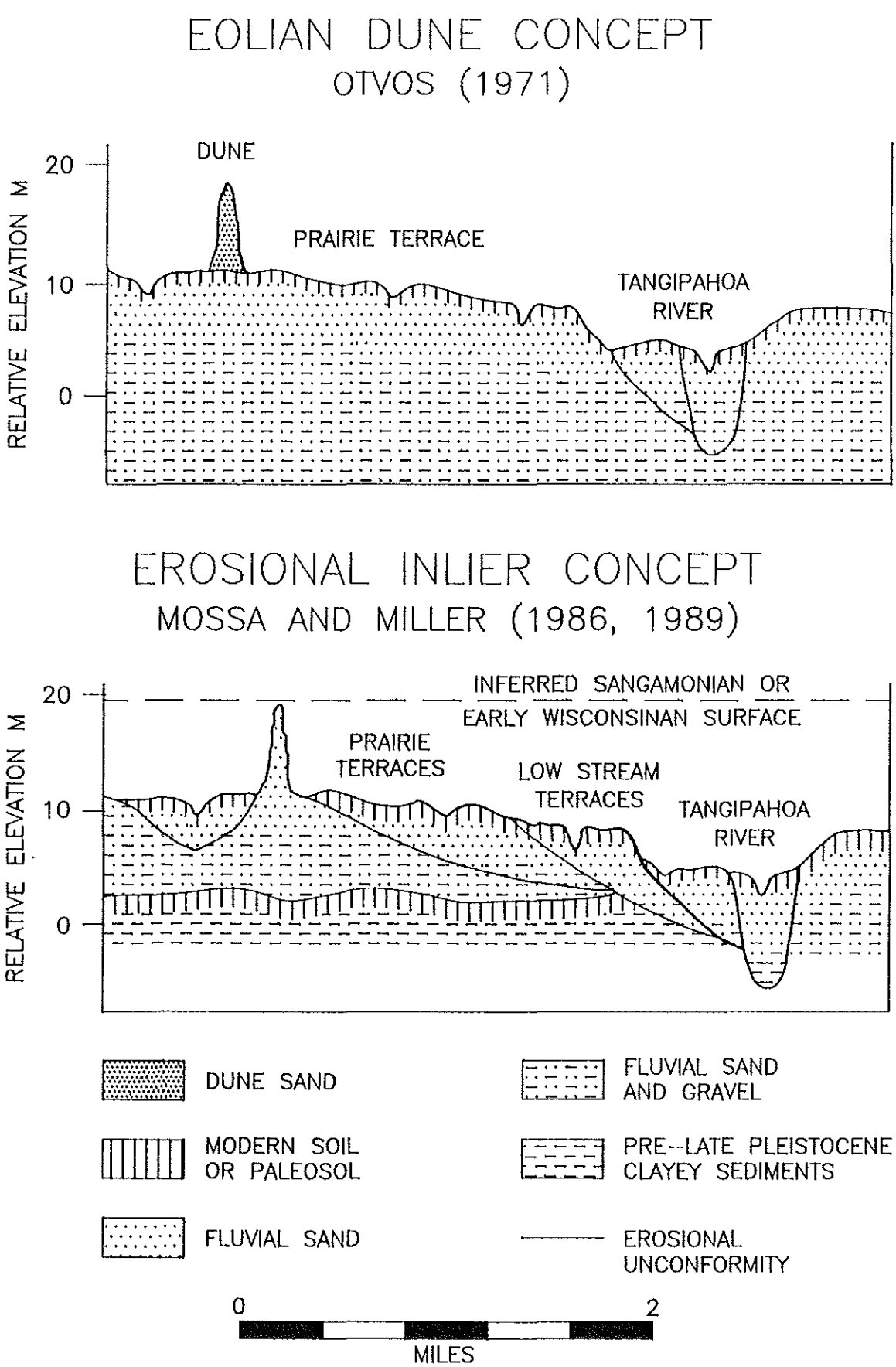


Figure 12. Alternative explanations for the origin of the sand hills that occur on the Prairie Terrace within the Florida Parishes. Modified from Mossa (1988:Figure 23).

a landform on which numerous unrecorded archeological deposits have been observed (Joann Mossa, personal communication 1986).

The surface of the Eastern Prairie Terrace predates the human occupation of the coastal zone. As a result, in situ archeological deposits will be restricted to the surface of the loess deposited on its alluvial plains. Buried archeological deposits can be present only within the Holocene sediments which have accumulated upon the Eastern Prairie Terrace. However, buried archeological deposits can be expected to be present within the Holocene deposits of the many bayous, streams, and small rivers entrenched into this surface.

Holocene River Valleys

Small to moderate-size valleys of rivers such as the Amite, Comite, Tangipahoa, and others have entrenched relatively narrow valleys into the Prairie Complex. These valleys occupy entrenched, narrow, and well developed alluvial valleys. Except for the Amite and Pearl Rivers, little, if anything, is known about the geomorphology and Pleistocene history of these valleys.

Pearl River Valley. The alluvial plain and associated terraces of the Pearl River Valley has been studied by Gagliano and Thom (1967) and Gagliano (1979), who found two levels of Deweyville Terraces flanking the alluvial valley of the Pearl River. In places, the lower Deweyville Terrace is partially buried by Holocene backswamps that form the modern alluvial plain. Both terrace levels exhibit the typical oversize meander loops and ridge and swale topography that characterize the Deweyville Terrace elsewhere within the Gulf Coastal Plain.

Unpublished work done for Shell Oil Company indicates that the entrenched valley of the Pearl River is filled by over 24 m of Holocene alluvium (LeBlanc 1988:184). The upper 6 to 10 m of valley fill consists of fine-grained, sometimes organically-rich sediments. The remaining lower part of this valley is filled with sand that apparently grades downward into gravelly sand. Because of the quality of data illustrated by the foundation borings, it is impossible to determine the precise age, stratigraphy, or depositional environment of these sediments. The fine-grained portion of the valley fill presumably consists of vertically aggraded overbank and, possibly, even estuarine sediments (LeBlanc 1988:184). Therefore, a strong possibility exists that buried archeological deposits occur within the fine-grained deposits of this valley fill (Pearson et al. 1986).

keep

Calcasieu River Valley. Unpublished Shell Oil Company research indicates that the former, entrenched valley of the Calcasieu River lies 7.5 km east of its modern channel and Cameron, Louisiana within the Chenier Plain. The 56 m thick valley fill appears to consist of three vertically-stacked upward-fining depositional sequences of possible fluvial origin. Presumably, the fine-grained portion of each cycle consists of vertically aggraded overbank and, possibly, even estuarine sediments (LeBlanc 1988:182). A strong possibility exists that buried archeological deposits occur within the fine-grained portion of each of the coarsening upward sequences (Pearson et al. 1986).

Amite River Valley. Detailed work by Autin (1989) within the Amite River Valley has subdivided its valley fills into three allostratigraphic units called the Magnolia Bridge, Denham Springs, and Watson Alloformations. Autin defined, mapped, and formally mapped each alloformation on the basis of cross-cutting relationships, alluvial plain morphology, facies geometry, and soil development. He measured and mapped these geomorphic properties from field data from several hundred borings.

Each alloformation consists of a distinct package of meander belt sediments covered by vertically accreted overbank sediments. Varying according to alloformation, the upper 2 to 4 m of each 6 to 10 m thick alloformation consist of fine-grained, vertically accreted overbank deposits. Underlying the overbank sediments are sands and gravelly sands which accumulated as coarse-grained point bars within a flashy

meandering river (Autin 1989:30-34). In addition to surface sites present on the Amite River Alluvial Plain, e.g. Gagliano (1963), buried archeological deposits should occur within the overbank deposits of these alloformations.

Summary

Contrary to many models that have been proposed previously, the Prairie Complex is a complex assemblage of geomorphic surfaces and allostratigraphic units that vary greatly in age and origin. The Prairie Terrace, which forms the surface of the Prairie Complex, consists of numerous constructional surfaces, such as alluvial plains, meander belts, and a barrier island system. As in the Florida Parishes, some of these surfaces have been altered substantially by erosion. Although they differ greatly in age, all the Prairie Terrace and associated allostratigraphic units that form the Prairie Complex predate human occupation of this area. As a result, archeological deposits will occur only on the surface of the Prairie Complex, except in areas that have been locally buried or disturbed.

However, the Late Pleistocene and Holocene sediments that fill valleys entrenched into the Prairie Complex by various bayous, streams, and river all should contain buried archeological deposits. The precise history of the formation and filling of these valleys will determine the temporal range and spatial distribution of the surficial and buried archeological deposits present within them. Autin (1989) has developed a methodology by which the stratigraphy and history of these valley fills can be delineated.

Mississippi River Alluvial Plain

The Mississippi Alluvial Plain is continually being reshaped by the Mississippi River and its tributaries. Fluvial processes and the landforms and sedimentary deposits they have created strongly influence the formation, preservation, and distribution of archeological deposits. Within meander belts, the lateral migration of the Mississippi has constantly reworked the surface and sediments of active meander belts. As noted in Chapter 3, the avulsion of its channel has changed its course and created new meander belts at least five times. Between meander belts, the vertical accretion of lacustrine, swamp, and crevasse sediments has created a thick sequence of fine-grained, often organically-rich sediments (Fisk 1947; Saucier 1974).

keep, don't change.

The appearance, depositional environment, occurrence, character, and sediments of fluvial landforms and surfaces within the coastal zone are summarized by both Fisk (1947) and Saucier (1969). In addition, Walker (1984) and Flores et al. (1985) extensively review the sedimentology and geomorphology of meander belts and backswamps. Also, Fisk (1947) expertly explains fluvial processes, such as cutoffs and lateral accretion and Farrell (1989) adeptly illustrates the internal structure and formation of natural levees and crevasse splays. Finally, Coleman (1966a), Tye and Kosters (1986), and Farrell (1989) provide detailed reviews of the depositional processes, landforms, and the sediments of the backswamps and lakes found within the Atchafalaya Basin. Within the coastal zone, the Mississippi River Alluvial Plain consists of three geomorphic regions recognizable on the basis of modern physiography. They are Meander Belt No. 3, Atchafalaya Basin, and Meander Belt No. 1 (Saucier and Snead 1990) (Figure 1). It should be noted that Saucier and Snead (1990) and Autin, Burns et al. (1990) number meander belts from youngest to oldest, rather then from oldest to youngest, as done by Saucier (1974, 1981) (Figures 1 and 8).

new LP

Loess Covered Terrace

Meander Belt No. 1

Meander Belt No. 1 is the youngest of five meander belts mapped by Saucier and Snead (1990) and Saucier (1974) within the Mississippi Alluvial Plain. This meander belt consists of landforms created by the meandering of the currently active course of the Mississippi River. Most of this meander belt consists of well-defined ridges and swales formed by the lateral accretion of point bars within a laterally migrating

Mississippi River course. About 30 to 35 m of point bar deposits consisting of silty sands and silts that grade downward into clean sands and gravels underlie the ridge and swale topography. Numerous abandoned channels in various stages, ranging from being filled from open water, i.e., "oxbow lakes," to completely filled, i.e., "clay plugs," are conspicuous features within the ridge and swale topography. The clay plugs within the abandoned channels consist of 25 to 30 m of uniformly dark gray, soft, underconsolidated, organically-rich clays and silt. Natural levees rise as much as 8 m above the adjacent meander belt surface. They are highest adjacent to channels and courses of the Mississippi River and slope gently away for as far as 3 to 5 km. Natural levees are composed of vertically deposited, firm to stiff, mottled gray and brown, well-oxidized silty and sandy clays. (Fisk 1947; Saucier 1969; 1974; Farrell 1989).

Meander Belt No. 1 represents the upper surface of an unnamed allostratigraphic unit, informally called a "complex." The former cutbanks of the outermost channels of the meander belt form the sides of this and other meander belt complexes. The bottom of this complex is an erosional unconformity cut into the underlying fluvial deposits by the action of the Mississippi River channel migrating back and forth across its alluvial plain.

The width of Meander Belt No. 1 becomes distinctly narrower downstream, particularly in the transition zone between the alluvial valley and the deltaic plain (Figure 1). The downstream increase in the thickness and areal extent of difficult-to-erode clayey backswamp deposits increasingly restricts the ability of the river to migrate. In addition, the ability of the river to meander is further restricted by a decrease in the amount of the sandy bedload, and by changes in its hydrologic regime. As a result, the rapidity at which the meander belt is reworked by the back-and-forth lateral migration also decreases downstream (Fisk 1947; Saucier 1974).

Prior to 2800 years ago, the Mississippi River occupied Meander Belt No. 3 along the western wall of the Mississippi Alluvial Valley (Figure 1). At this time, a poorly-developed drainage network probably occupied the backswamp. The backswamp may have partially or completely buried Meander Belt No. 4. (Saucier 1974, 1981). Remnants of Meander Belt No. 4 might be fragments of a buried meander belt mapped by Saucier (1969) adjacent to the Meander Belt No. 1, within West Baton Rouge and Iberville Parishes.

The present course of Meander Belt No. 1 was established 2800 years ago by a channel avulsion. Initially, the avulsion established a channel that slowly extended along the eastern valley wall of the Mississippi Alluvial Valley. During the next few hundred years, a nonmeandering channel incised its thalweg into the underlying backswamp deposits, and built a low and relatively confining levee. As this course diverted more flow into the channel, it cut deeper into the underlying fluvial sediments as the natural levee continued to grow. Incipient meander loops developed as small twists and turns in its channel. Eventually, the full flow of the Mississippi River was diverted into Meander Belt No. 1, and its course developed mature natural levees and meander loops (Farrell 1989:159-164). Because the mature natural levees were high and confining, deposition of sediments on the natural levee was restricted to the concave side of the meander loop. Also, the height of the levees prevented floodwaters from uniformly overflowing and submerging the entire levee. The adjacent backswamp usually was flooded through crevasses, resulting in the development of crevasse splays. As a result, most of the natural levee was high and dry during a typical annual flood (Farrell 1989:164).

Furthermore, the back-and-forth lateral migration of the Mississippi River has completely reworked the upper 30 to 35 m of the alluvial plain within Meander Belt No. 1. As the river course migrated, its cutbank removed the upper 30 to 35 m of its alluvial plain, while point bar deposits accumulated on its opposite bank. As a result, backswamp, estuarine, meandering river, and braided stream sediments older than 2800 years have been completely removed and replaced with sediments younger than 2800 years old.

In a similar manner, the rate at which the channel migrates back and forth across the meander belt will affect the average age of the fluvial and archeological deposits that form an alloformation. Within the wider segments of Meander Belt No. 1, the river channel frequently migrates back and forth across the meander belt. As a result, the bulk of the sediments of this complex and the archeological deposits they contain will be considerably younger than 2800 years old. Adjacent to and within the narrower segments of this meander belt, a greater percentage of older fluvial sediments and their archeological deposits might survive, because of the reduced rate and extent of the lateral migration.

Meander Belt No. 3

The reexamination of available aerial photography and topographic maps demonstrates, as suggested by Saxton (1986:33, 36), that Meander Belt No. 3 (Saucier, 1974) consists of at least two major Mississippi River meander belts and a loess-covered, unnamed terrace (Figure 13). For purposes of this report, the relict Mississippi River meander belts are called the Lake La Pointe and Bayou Teche Meander Belts.

Unnamed Loess-Covered Terraces. Unnamed loess-covered terraces lie adjacent to the valley wall of the Mississippi Alluvial Valley within the north-central coastal zone (Figure 13). Examination of available topographic and geomorphic maps, soil surveys, and aerial photography demonstrates that loess-covered terraces consist of an unnamed Red River meander belt and fragments of ~~younger~~ older Mississippi River meander loops. Miller et al. (1985:59-61) and Saxton (1986:33) demonstrate that up to 4 m of Peoria Loess, overlain in places by Holocene alluvium, cover these terraces.

The unnamed Red River meander belt consists of a short segment of an abandoned river course that is about 4.5 km long and nine km long. This meander belt extends from the southern part of T.8 S., R.5 E. to T.9 S., R.5 E. within St. Martin Parish. It exhibits meander loops with small radii of curvature comparable to those of the modern Red River. Where the accumulation of younger alluvium and slopewash has buried the loess-covered topography of this meander belt adjacent to the valley wall, small radius meander bights document its presence. Immediately north of this terrace segment, a Red River-sized meander bight forms a part of the valley wall just east of Carencro, Louisiana, within Lafayette Parish.

The exact age of these terraces is uncertain. They must date between 30,000 years ago, the age of meander belt deposits that form the Prairie Terrace, and 21,000 years ago, the start of Peoria Loess deposition. Although both terraces predate human occupation of the area, these terraces form some of the oldest known geomorphic surfaces within the Mississippi Alluvial Valley. Both San Patrice and Archaic sites have been located by Gibson (1990:102-103) upon fragments of the unnamed loess-covered terraces at Frozard, Louisiana and northeast of Lafayette, Louisiana.

Lake La Pointe Meander Belt. Saxton (1986:36) noted that Meander Belt No. 3 contains a "Pre-Teche-Mississippi meander belt". For this report, it is called the "Lake La Pointe Meander Belt" after Lake La Pointe, which lies within an abandoned channel of this meander belt within Sec. 36 of T. 9 S., R. 5 E. of St. Martin Parish. Topographic maps, soils surveys, aerial photography, and studies by Saxton (1986: Plate 1) and Rouly (1989: Plate 1) indicate that the Lake La Pointe Meander Belt can be observed within a strip between Bayou Teche and the Prairie Terrace from Arnaldville, Louisiana to just north of Iberville, Louisiana. Additional fragments of this meander belt occur between Catahoula Coulee and Bayou Teche north of Iberville on the opposite side of Bayou Teche (Figure 13). An additional, isolated fragment of partially buried Mississippi River ridge and swale topography that may belong to the Lake La Pointe Meander Belt occurs northwest of Baldwin, within the northwest quarter of T. 14 S., R. 9 E. (Lytle et al. 1959:Sheet 12).

The Lake La Pointe Meander Belt is distinct from the Bayou Teche Meander Belt. First, the ridge and swale topography of the Lake La Pointe Meander Belt lies at an elevation of five to six m. This elevation

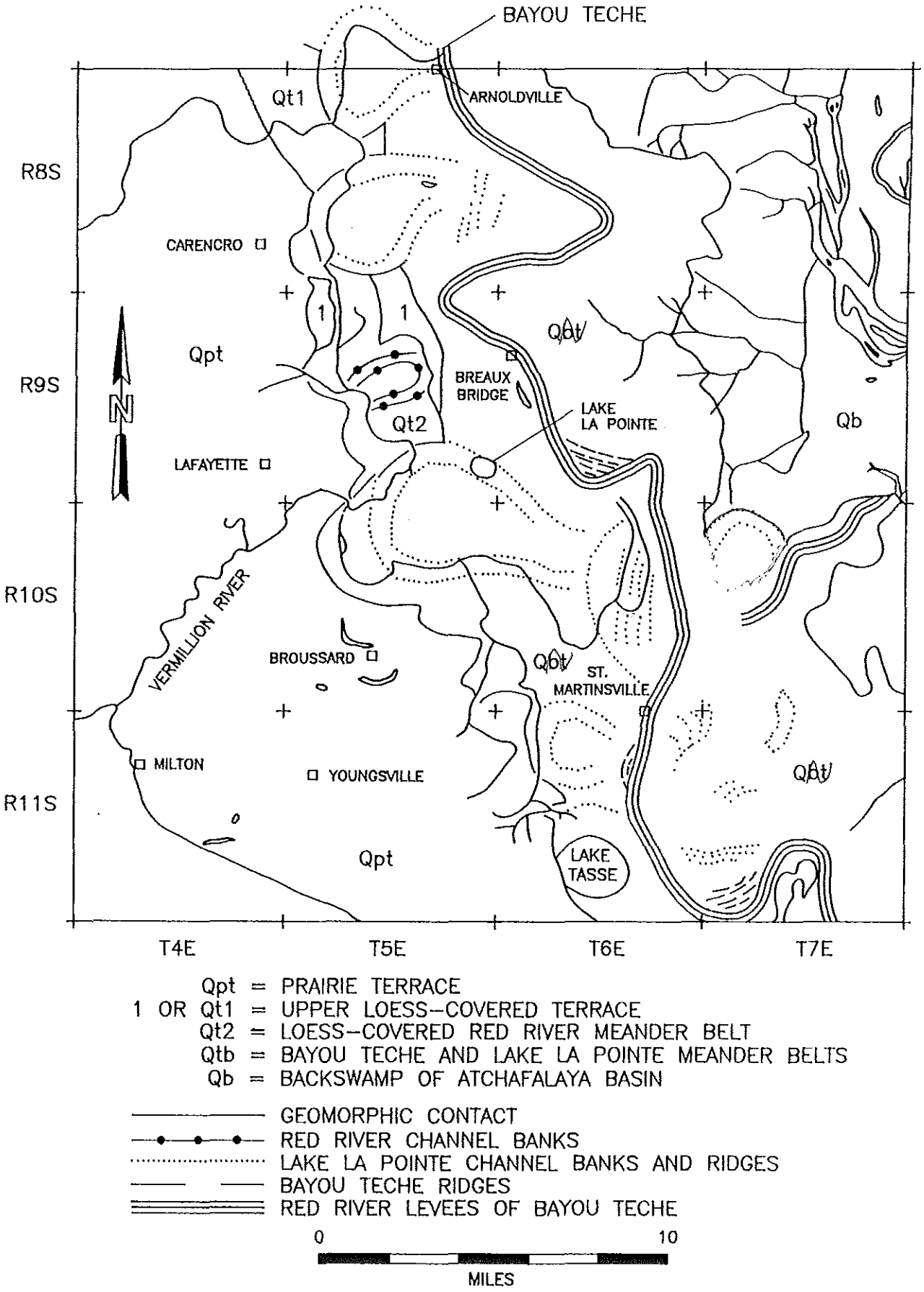


Figure 13. Geomorphic sketch map of Meander Belt No. 3 near Lafayette, Louisiana.

lies about three m below the level of the ridge and swale topography in the Bayou Teche Meander Belt, although the elevation of the Lake La Pointe Meander Belt includes an unknown thickness of younger overbank alluvium. Finally, the meander loops of the Lake La Pointe Meander Belt are extremely complex and well-developed, in contrast to the relatively simple meander loops of the Bayou Teche Meander Belt (Figure 13). The meander loops of the Lake La Pointe Meander Belt are comparable in channel width and radius of curvature to the Mississippi River and lack any cover of Peoria Loess (Saxton 1986:36; Rouly 1989:36-37).

The meander loops of the Lake La Pointe Meander Belt that can be mapped are concave towards the Bayou Teche Meander Belt, indicating that the river course with which they are associated lies buried beneath the Bayou Teche Meander Belt. Because it is highly unlikely that a younger meander belt would build exactly over the abandoned river course of an older meander belt, the Bayou Teche Meander Belt either reoccupied the abandoned course of the Lake La Pointe Meander Belt, or formed from the abrupt aggradation of its main river course. If so, it could contain Archaic archeological deposits unique to the coastal zone.

Bayou Teche Meander Belt. The most recent and best-preserved of the meander belts within Meander Belt No. 3 is the Bayou Teche Meander Belt (Figure 13). On the basis of geomorphology, the Bayou Teche Meander Belt can be divided into northern, central, and southern segments. Within the coastal zone, the northern part of the Bayou Teche Meander Belt extends from north of Arnaldville to St. Martinsville, Louisiana. The central part of the Bayou Teche Meander Belt consists of the channel segment between St. Martinsville and Morgan City, Louisiana. Between Morgan City and Houma, Louisiana, Bayou Boeuf and Black Bayou form the southern part of the Teche Meander Belt.

The northern and central parts of the Bayou Teche Meander Belt have a complex natural levee system consisting of as many as three natural levees flanking both sides of Bayou Teche. From the center of Bayou Teche outward, they are informally designated the "outer," "middle," and "inner" natural levee. Respectively, the outer, middle, and inner natural levees represent natural levees formed by sediments deposited sequentially by the Teche-Mississippi, Teche-Red River, and Bayou Teche (Figure 14) (Gould and Morgan 1962; Morgan 1976). The chronology of the Mississippi and Red Rivers can be used to estimate the general age of the surface of each natural levee and the age range of the sediments that form them.

The innermost set of natural levees, called the "inner natural levee," occurs along the narrow channel of the northern section of Bayou Teche. The inner natural levee is the modern, actively aggrading natural levee of Bayou Teche. Unlike the relict outer and middle natural levees, the inner natural levee is the site of active sedimentation. The inner natural levee occurs only where the abandoned channel of the Teche-Red River has sufficiently filled to form dry land (Gould and Morgan 1962).

Between the inner and outer natural levees, the middle natural levee is a relict, very narrow, and steeply sloping natural levee composed of reddish-colored alluvium. The middle natural levee is underlain by reddish-colored alluvium deposited by the Teche-Red River between 3500 to 2000 B.P. The distinctive red color of this alluvium is derived from the Permian redbeds of Oklahoma and northeast Texas. This alluvium was deposited by the Teche-Red River as channel fill during the waning stage of the diversion of the Red River from Bayou Teche. About 2000 B.P., the middle natural levee became a relict landform when the Teche-Red River abandoned the Bayou Teche course (Figure 14) (Gould and Morgan 1962; Morgan 1976).

The outer natural levee is a relict, very broad, and very gently sloping natural levee composed of gray to brown silts and clays. The outer natural levee consists of overbank sediments deposited by the Teche-Mississippi River between 6000 to 3500 B.P. The overbank sediments overlie point bar, channel fill, and backswamp deposits. About 3500 B.P., the outer natural levee became a relict landform when the Teche-Mississippi abandoned Bayou Teche as its course (Figure 14) (Gould and Morgan 1962).

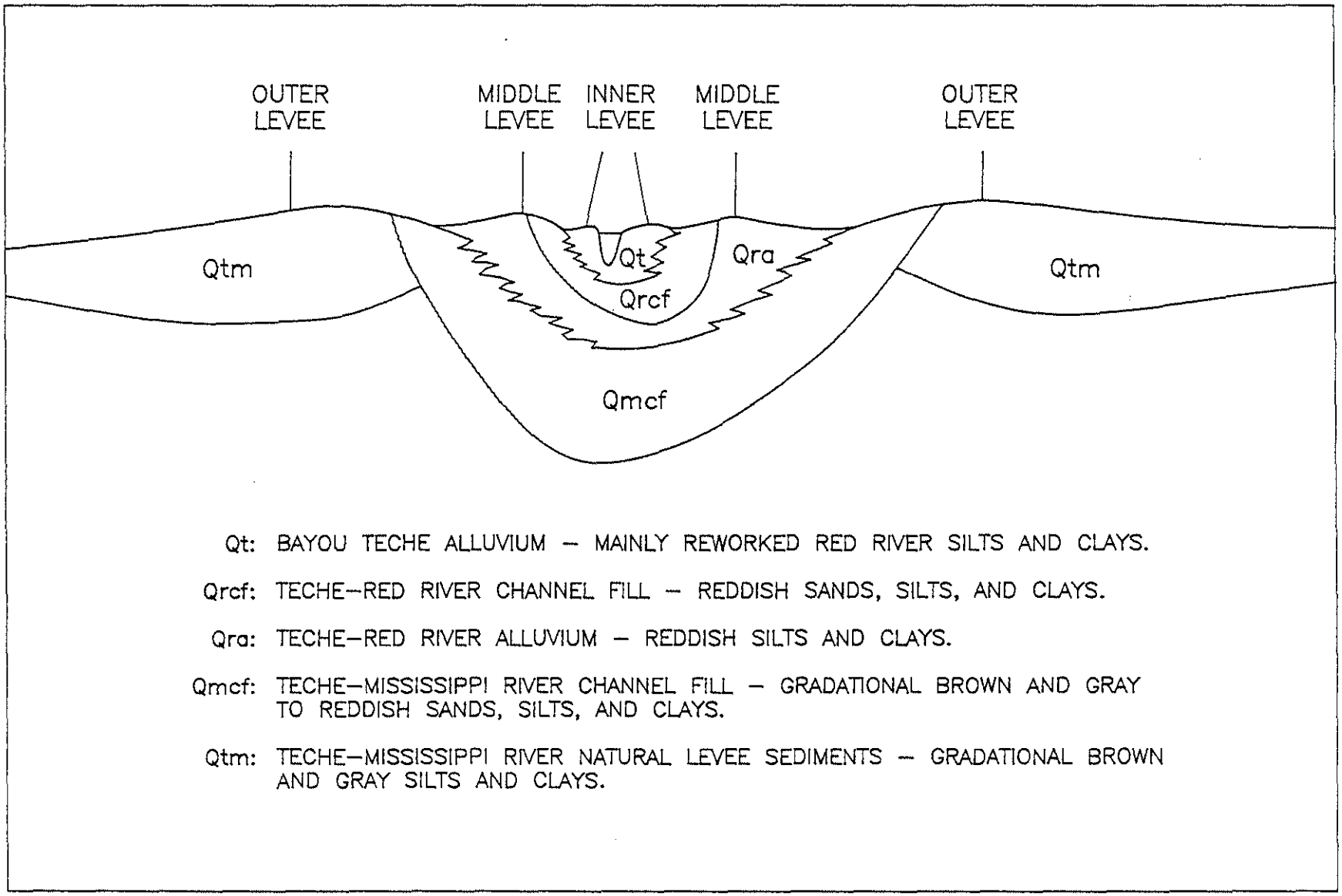

OUTER LEVEE
MIDDLE LEVEE
INNER LEVEE
MIDDLE LEVEE
OUTER LEVEE
Qtm
Qt
Qrcf
Qra
Qtm
Qmcf
Qt: BAYOU TECHE ALLUVIUM – MAINLY REWORKED RED RIVER SILTS AND CLAYS.
Qrcf: TECHE–RED RIVER CHANNEL FILL – REDDISH SANDS, SILTS, AND CLAYS.
Qra: TECHE–RED RIVER ALLUVIUM – REDDISH SILTS AND CLAYS.
Qmcf: TECHE–MISSISSIPPI RIVER CHANNEL FILL – GRADATIONAL BROWN AND GRAY TO REDDISH SANDS, SILTS, AND CLAYS.
Qtm: TECHE–MISSISSIPPI RIVER NATURAL LEVEE SEDIMENTS – GRADATIONAL BROWN AND GRAY SILTS AND CLAYS.

Figure 14. Diagrammatic cross-section of Bayou Teche at St. Martinville, showing the relationships between natural levees and the deposits of the Mississippi River, the Red River, and Bayou Teche. Modified from Gould and Morgan (1962).

The natural levee along the southern part of the Bayou Teche natural levee is similarly complex. It extends up the Bayou Teche Meander Belt from Houma, Louisiana, and is built upon the natural levees and deposits of both the Teche-Mississippi and Red Rivers. This natural levee is three m thick at Houma, decreasing in thickness to about 60 cm at Gibson, Louisiana. Between Gibson and Morgan City, Louisiana, the deposits and surfaces of this natural levee merge with the surfaces of the outer and middle natural levees (Gould and Morgan 1962:303-307).

Summary. Meander Belt No. 3 of Saucier (1974) and Saucier and Snead (1990), as currently mapped, contains at least three recognizable geomorphic surfaces. The oldest of these surfaces consists of loess-covered terraces associated meander bights indicative of a Late Wisconsinan aged, Red River-sized fluvial system. The next youngest geomorphic surface, the Lake La Pointe Meander Belt, is a partially buried, Early Holocene Mississippi River meander belt. The fluvial deposits of the youngest of the three geomorphic surfaces, the Bayou Teche Meander Belt, have accumulated on top of, and partially buried, the Lake La Pointe Meander Belt. The Bayou Teche Meander Belt can be subdivided into three distinct geomorphic surfaces, with sequences of fluvial deposits associated with each surface. Each of these surfaces, together with their associated fluvial deposits, represent a distinct period of fluvial activity along Bayou Teche.

Atchafalaya Basin

The Atchafalaya Basin is a large flood or interdistributary basin that lies between the natural levees of the Mississippi River, Bayou Teche, and Bayou Lafourche (Figure 1). The Atchafalaya Basin is approximately 110 km long, and ranges from 20 to 60 km wide. This basin consists of about 2830 km^2 of backswamps and lakes; the southern half lies within the coastal zone (Tye 1986).

Currently, the lower half of the basin consists of a complex network dividing, subdividing, and rejoining distributaries of the Grand and Atchafalaya Rivers. The natural levees of these distributaries and large distributary crevasses of the Mississippi River and Bayou Teche subdivide the Atchafalaya Basin into numerous subbasins. Inflow from the distributaries of these rivers and formerly active crevasses emptied into large lakes, e.g. Lake Faussse Pointe, Grand Lake, and Lake Verret. Prior to cutting the Wax Lake Outlet, the surface waters of the basin collected in these lakes and drained into Atchafalaya Bay through the relatively short, deep, lower Atchafalaya River and associated Berwick Bay (Tye 1986).

Underlying the lake bottoms and backswamps of the Atchafalaya Basin is 25 to 35 m of fine-grained flood basin deposits; these deposits overlie fluvial sands and gravel. The fluvial sands and gravels consist of Late Pleistocene braided stream deposits and, possibly, Early Holocene point bar sediments. The overlying fine-grained sediments consist of alternating layers of backswamp sediments and lacustrine sequences. A lacustrine sequence consists of clayey, open-lake sediments that grade upward into a lacustrine delta sequence. Each lacustrine sequence represents the periodic subsidence of swamps within the Atchafalaya Basin, which thereby formed large lakes. Later, lacustrine deltas filled in these lakes, creating basin-wide swamps, which eventually subsided to form lakes; the cycle then is repeated (Coleman 1966a; Tye 1986).

Mississippi Delta Plain

The Mississippi Delta Plain is a composite geomorphic surface that consists of a series of coalesced delta plains. The surface morphology of each delta plain is dominated by an extensive network of distributaries that radiates out from an abandoned or active trunk channel systems extending from the Mississippi River Alluvial Plain into the Delta Plain. Each of these distributary networks is separated by a series of connecting interdistributary lakes and ponds. The lakes and ponds increase in size and coalesce

towards the coast, forming larger, interdistributary bays that open to the Gulf of Mexico (Fisk 1960; Kolb and Van Lopik 1958; Frazier 1967; Coleman 1982).

The sedimentology and geomorphology of the Mississippi Delta has been studied and described in detail by many scientists. Although some of the basics of their work are summarized below, the serious researcher needs to study the published works of several authors in order to grasp the fundamentals of the deltaic processes within the Mississippi Delta Plain. Coleman and Gagliano (1964), Fisk (1955, 1960), Gould (1960), Penland et al. (1985), and Penland (1990) are basic references concerning the sedimentology and geomorphology of the shoal-water deltas that comprise almost all of the delta complexes. In addition, Kosters (1989) and Tye and Kosters (1986) describe the active processes as well as the sediments that characterize the interdistributary bays of the delta plains. Finally, Coleman (1982), Kolb and Van Lopik (1966), and Frazier (1967) all summarize important aspects of the ecology, geomorphology, and sedimentology of the Mississippi River Delta; these are critical to an understanding of its structure and evolution.

Deposition of Delta Complexes

The history of a delta complex, as defined by Frazier (1967), starts with an upstream diversion of an active course of the Mississippi River. Gradually, the flow of the preexisting course is captured by a new course that offers a gradient advantage to the river's flow to the Gulf of Mexico. After stream capture is complete, the new course builds a shallow water delta, called a "shoal-water delta" in the Gulf of Mexico by depositioning its sediment load. The continuous deposition of sediment rapidly extends the delta gulfward, and lengthens the courses of its distributaries. Eventually, long-term delta lobe progradation leads to an overextension of the distributary network, and to a decrease in hydraulic efficiency, which results in an upstream diversion of the trunk channel. Again, the channel switches to a shorter, more efficient course with a steeper gradient, and generates a new delta complex where a new delta is initiated. The Mississippi River is currently building a shelf margin delta, having prograded across the Continental Shelf (Fisk 1960; Frazier 1967; Coleman 1982).

Destruction of Delta Complexes

Once a delta complex is abandoned, it starts to subside, in this case into the Gulf Mexico. This subsidence, defined as the "the downward displacement of land relative to a fixed datum," is the net effect of numerous processes. Because delta complexes consist of fine-grained, organic-rich sediments, the primary consolidation, secondary compression, and oxidation of organic matter contribute greatly to subsidence. In addition to these processes of soil consolidation, regional subsidence is caused by the regional downwarping of the Gulf Coast Geosyncline. Locally, subsidence can be accentuated by faulting, salt extraction, sulphur mining, fluid withdrawal, or clay or salt diaprism. Finally, eustatic sea level rise is a significant contributor to regional subsidence (Roberts, 1987).

Regardless of the processes causing it, the result of relative sea level rise is a net downward displacement of land relative to sea level. The effects of subsidence and sea level rise can only be offset by the input of large amounts of terrigenous sediment into the delta plain. This accumulation of terrigenous sediment and production of organic matter within a delta plain results in the vertical accretion of delta sediments sufficient to offset subsidence. As a result, a stable delta plain is maintained (Roberts 1987).

However, when a distributary system is abandoned, the supply of terrigenous sediment virtually ceases. As a result, the vertical accumulation of delta sediments is insufficient to offset subsidence; the delta plain will start to sink below the level of the Gulf of Mexico. At this time, marine processes erode and rework the seaward edge of the abandoned delta complex. The sediments eroded from the abandoned delta plain are then redeposited as transgressive barrier complexes, which evolve as the delta complex is consumed by landward movement of the shoreline (Penland et al. 1985; Roberts 1987).

Transgressive Cycle. Initially, subsidence generates a relative sea level rise in which the shoreface erosion of the distal end of a delta lobe transforms it into an erosional headland. The material eroded from this headland is redistributed by long shore currents to form a pair of barrier islands that flank either side of this headland, e.g. Grand, East Timbalier, and Timbalier Islands (Penland et al. 1981). Continued long-term relative sea level rise results in subsidence of the headland and detachment of the barrier shoreline, forming a lagoon between it and the delta plain. Between 1853 and 1978, this process created the lagoon that now lies behind the Isles Dernieres. As the delta subsides, the lagoon widens, because the surface of the delta sinks faster than the barrier can migrate towards the delta. Eventually, a wide lagoon, e.g. Chandeleur Sound, forms over the relict deltaic plain. The deltaic complex submerged lagoons are scoured and eroded by tidal currents. Finally, the barrier island is submerged, and shelf shoals, e.g. Tiger and Ship Shoal, are formed (Penland et al. 1985: 199-201).

Geomorphic Regions

On the basis of its surficial geomorphology, the modern Mississippi Deltaic Plain is divided into seven geomorphic regions. For purposes of this study, they are called the Pontchartrain Marginal Basin, St. Bernard Coastal Region, Lafourche Meander Belt, Terrebonne Coastal Region, Barataria Interlobe Basin, Plaquemine Coastal Region, and St. Mary Coastal Region (Figure 1).

Pontchartrain Marginal Basin

Lakes Pontchartrain and Maurepas lie within a large marginal basin that lies between the Mississippi Delta Plain and the Prairie Terrace (Figure 1). It is about 84 km long along its east-west axis and 38 km wide along its north-south axis. Lakes Pontchartrain and Maurepas are shallow tidal basins with an average depth of 3 to 4 m. Both lakes occupy about 436 km^2, or about 45 per cent of the basin. The remainder of the basin consists of relatively flat swamps and marshes that lie at or close to sea level. The inflow of fresh water from streams and small rivers that drain the adjacent Prairie Terrace and the shallowness of the lakes produce a variety of environments ranging from freshwater lacustrine to brackish water (Saucier 1963).

The Pontchartrain Marginal Basin is a remnant of a former embayment of the Gulf of Mexico, which once extended up the Mississippi River Valley. By 5500 years ago, rising sea level and subsidence flooded the Prairie Terrace to the current northern edge of this basin and to the eastern half of the Mississippi River Valley up to Baton Rouge. Longshore currents built a barrier island and shoal trend, called the "New Orleans Barrier Island Trend," from the mouth of the Pearl River southwest into the Gulf to the approximate area of New Orleans (Saucier 1963; Otvos 1975:354).

Beginning at 4800 years B.P., the Mississippi River shifted its course from Meander Belt No. 3 to Meander Belt No. 2, causing a diversion of flow down the eastern and central part of the Mississippi Alluvial Valley. Meander Belt No. 2 filled in the Mississippi River Valley and built the Metairie Delta Complex, which formed a large bay by connecting with the end of New Orleans Barrier Island Trend (Figure 9). Only the southwesternmost islands of this barrier trend were engulfed by the delta complex. At this time, the combination of the delta lobe and barrier island created the Pontchartrain Marginal Basin, which was occupied by a large brackish water bay. Between 3100 to 2900 years ago, the barrier island extended itself along the south edge of the Metairie Delta Lobe (Saucier 1963; Otvos 1975:354).

From about 3400 to 1600 years B.P., the St. Bernard Delta Complex (Frazier 1967) formed two major delta lobes that prograded from the New Orleans area (Figures 8 and 9). The larger delta, La Loutre Delta, prograded eastward to form most of St. Bernard Parish. It completely buried the barrier island system that separated "Pontchartrain Bay" from the gulf up to the Pearl River Delta creating Lake Pontchartrain (Saucier 1963; Otvos 1975:354).

St. Bernard Coastal Region

The St. Bernard Coastal Region consists of the abandoned Metairie and St. Bernard Delta Complexes. This region consists of an expanse of swamp and marsh with numerous lakes transected by the natural levees of relict Mississippi River distributaries. The swamps and marshes lie at sea level and the natural levees rise less than 1 m above it. ~~Currently, these marshes are the most rapidly eroding areas in southwestern Louisiana.~~ southeastern ← ...rapidly keep

As previously discussed, a shift in the course of the Mississippi River resulted in the progradation of the Metairie Delta Complex. It built out into the Gulf of Mexico a short distance past New Orleans; later, the Metairie Delta Complex was buried by the St. Bernard Complex (Frazier 1967:Figure 12).

Because of its age, numerous Archaic archeological deposits probably lie upon and within the buried delta plain of the Metairie Delta Complex. Unfortunately, the extent to which the delta plain and aggradational facies of the Metairie Delta Complex were eroded by marine transgression prior to burial is unknown. As a result, the extent to which the delta plain and its Archaic sites remain intact, but buried, cannot be determined.

From about 3400 to 1600 years B.P., another delta complex, the St. Bernard Delta Complex, prograded two major delta lobes from the New Orleans area (Figure 9). The larger delta, La Loutre Delta, prograded eastward to form most of St. Bernard Parish. A smaller delta, the Des Familles Delta, prograded southward from the New Orleans region. From 1800 to 600 years B.P., only the Bayou Sauvage Delta of St. Bernard Delta Complex remained active. Since its abandonment, the shore has rapidly transgressed over its surface, resulting in the continuing destruction of the delta plain and associated archeological deposits (Frazier 1967:Figure 12; Weinstein and Gagliano 1982:Figure 1).

Within this area, the sediments of both delta complexes buried Middle → Late Wisconsinan deltaic and fluvial plains drowned by Early Holocene sea level rise. These plains still retain the weathering zone developed within them, including an intact solum. The intact soil horizon indicates that some of the Paleo-Indian and Early Archaic archeological deposits that accumulated on these plains might have survived the marine transgression (~~Frazier 1967~~ Saucier 1977:10-13; Miller 1983).

Plaquemine Coastal Region

The Plaquemine Coastal Region consists entirely of the Plaquemine Delta Complex (Figures 1 and 9). From just south of New Orleans to just north of the Head of Passes, it consists of a single shoal-water delta that prograded southward across the delta plain of the St. Bernard Delta Complex. Archeological sites have been found adjacent to the channels of the subdeltas (Gagliano 1984:37). The shoal-water delta consists primarily of a trunk channel flanked on both sides by a series of subdeltas. Adjacent to the trunk channel, the subdeltas are covered by brackish water marsh. The distal edge of the subdeltas is covered by salt water marsh (Coleman 1982).

From the Head of Passes south, the Balize Delta forms the Plaquemine Delta Complex. The Balize Delta is a shelf edge delta that formed as the Plaquemine Delta Complex prograded off the older delta plain onto the deeper waters of the ~~outer~~ Continental Shelf. Because of this change in water depth, the Balize Delta developed its unique "birdfoot" shape. Because this delta formed only within the last 450 years, no prehistoric deposits are expected on it (Coleman 1982).

Barataria Interlobe Basin

The Barataria Interdistributary, or Interlobe, Basin is a 150 km long basin that lies between the natural levees of Bayou Lafourche to the southwest and the natural levees of the Mississippi River to the

northeast (Figure 1) It is 52 km wide at its southeast end, where it opens onto Barataria Bay. Its upper third, which includes Lac Des Allemands, is covered by forested swamp. Fresh and intermediate swamp covers its middle third, except for the open waters of Lake Salvador. The remaining gulfward third consists of brackish and saline marsh (Kosters 1987, 1989; Kosters et al. 1983).

The project area lies on the western edge of the Barataria Interlobe Basin. This basin formed about 2000 B.P. with the progradation of the Lafourche Delta Complex southward into the area, and with the later development of the Plaquemine deltaic complex (Figure 9). This basin provided a rich source of faunal and flora resources for the prehistoric inhabitants of the area. Since 2000 B.P., the configuration, sedimentary environments, fauna, and flora of the Barataria Interlobe Basin have changed with time (Kosters 1987, 1989; Kosters et al. 1983).

Delta Distributary

Bayou Lafourche Meander Belt

The Lafourche Meander Belt consists of a 51 km long segment of Bayou Lafourche between Donaldsonville and Thibodaux, Louisiana (Figure 1). This stretch of Bayou Lafourche occupies a poorly developed meander belt of the Mississippi River that is 0.7 to 1.0 km wide. Its natural levees rise about 5 m above the level of the adjacent backswamp or marsh, and extend about 3 to 4 km away from the banks of Bayou Lafourche (Kolb and Van Lopik 1966; Saucier 1969).

well

trunk distributary

This segment of Bayou Lafourche was a trunk channel that fed water and sediment to the Lafourche Delta Complex from about 2000 B.P. until it was artificially cut off in 1904. From before 2500 B.P. to 2000 B.P., this delta complex prograded along a course starting from the Mississippi River at Donaldsonville, Louisiana. About 2000 B.P., the prograding trunk channel split into two trunk channels; one channel prograded south to form the Terrebonne Delta and the other prograded to the southeast to form the Bayou Lafourche Deltas (Weinstein and Gagliano 1982:138-145). Prior to and after the split in the trunk channel, the segment between Donaldsonville and Thiboduax developed into a meander belt. The development of this meander belt probably either eroded or deeply buried the delta plain of the early Lafourche Delta Complex as its main channel, by processes described by Fisk (1960).

A review of the site files of the Louisiana Division of Archaeology indicates a lack of sites recorded within the natural levees of the Lafourche Meander Belt. The only recorded prehistoric site associated with this meander belt is the Bruly St. Martin Site, which lies on a crevasse distributary. Also, according to Neuman (personal communications 1990), historic maps show that villages and hamlets of historic Indian cultures densely covered the natural levees of the Lafourche Meander Belt. However, no archeological deposits associated with any of these village or hamlet sites have been recorded.

Duke/River

P

Delta Distributary

Reasons for the lack of archeological deposits, especially considering the dense distribution of historic Indian villages and hamlets, are unknown. The channel of Bayou Lafourche has migrated laterally too slowly to explain the lack of archeological deposits. Rather, prehistoric archeological deposits may have been buried by overbank sedimentation. However, the lack of historic Indian archeological deposits is more difficult to explain. Neuman (personal communications 1990) suggests that these, and possibly older surface sites, have been obliterated by the intensive use of the natural levees of Bayou Lafourche for the production of sugar cane, the construction of artificial levees, and for other development on its narrow natural levees. The lack of any comprehensive archeology of the Lafourche Meander Belt also might explain the lack of known sites. Before this problem can be solved, a comprehensive archeological survey, including archeological geology studies, of all or representative segments of the Lafourche Meander Belt is needed to answer these questions.

Delta Distributary

archaeological survey

Delta Distributary

Terrebonne Coastal Region

The Terrebonne Coastal Region lies within Assumption, Terrebonne, and Lafourche Parishes (Figure 1). The abandoned distributaries of the Teche Delta Complex that form part of the Late Holocene delta plain dominate the northeastern half of this region. They radiate southeastward from Bayou Teche at Morgan City until they disappear under the delta plain of the Lafourche Delta Complex. Within the southeastern half of this region, the Lafourche Delta Complex buried the delta plain of the Teche Delta Complex. The distributary ridges of the Lafourche Delta Complex radiate southeast from Houma and disappear beneath freshwater marshes, or are truncated by barrier island systems (Figure 15) (Penland et al. 1987, 1988; Weinstein and Gagliano 1982).

The presence of a shallow salt dome will affect a delta plain lying over it. The salt dome either will uplift or will slow its subsidence. As a result, that portion of the delta plain overlying a salt dome may subside at a rate that is slower than that of the surrounding delta plain. This differential subsidence can cause levee broadening, isolated or elevated levee segments, meandering of distributaries, and atypical distributary patterns (De Blieux 1949; Miller and Miller 1961:101). The resultant slightly elevated or broadened segments of natural levees might have provided attractive locations for prehistoric settlement and exploitation.

Within the southwestern part of the Terrebonne Coastal Region, e.g. the Lake Perchant 7.5' U.S.G.S. Quadrangle, a string of low, possibly partially buried shell ridges, called the "Bayou Perchant Shell Ridge" cut northeast - southwest across the delta plain. This shell ridge has been interpreted by some researchers, e.g. McIntire (1958), Penland et al. (1987), Smith et al. (1986), and Weinstein and Gagliano (1982), to be a relict, transgressive shoreline of varying significance (Figure 15). However, Weinstein and Kelley (1989) note that the Bayou Perchant Shell Ridge has a "meandering" trace unusual for a beach ridge. Also, the shell hash and internal geometry of this ridge is atypical of transgressive beach deposits. Therefore, the origin of the Bayou Perchant Shell Ridge is uncertain.

At this time, the chronology of the deltaic sediments that underlie the Terrebonne Coastal Region has yet to be definitely determined. It appears that the classic model presented by Frazier (1967, 1974) best describes the development of these sediments. However, the actual stratigraphy of the deltaic sediments that underlie this area is probably more complex than that envisioned by either Frazier (1967) or Penland et al. (1987; 1989) (Roger T. Saucier, personal communication 1990).

According to Penland et al. (1987) a significant transgressive shoreline, the "Teche Shoreline" erosionally truncated the delta plain of the Teche-Maringouin Delta Complex and separated it from the younger delta plain of the Lafourche Delta Complex. McIntire (1958) implies that the Bayou Perchant Shell Ridge is part of a shoreline that transgressed inland by as much as 40 km and eroded a "Teche ravinement surface" across the now-buried delta plain of the Teche Delta Complex. Penland et al. (1987) claim that the deposits of the Maringouin and Teche Delta Complex are part of a single complex separated from the overlying sediments of the Lafourche Delta Complex by a ravinement surface that eroded the surface of their "Late Holocene Delta Plain" (Figure 16).

As noted in Chapter III, Penland et al. (1988, 1989) probably miscorrelated the alloformations that formed the Terrebonne Coastal Region. As a result, the "Teche Ravinement Surface" and the "Late Holocene Delta Plain," as it eroded, actually represent the upper bounding surface of the Maringouin Delta Complex (Figure 16). In addition, this hypothesis has the "Earlier Holocene Delta Plain" as the upper bounding surface of the Outer Shoal Deltaic Plain; the Teche Delta Complex lies on top of the "Late Holocene Delta Plain," rather than beneath it.

This miscorrelation is supported by three pieces of evidence. First, the Bayou Perchant Shell Ridge does not appear to be part of a partially buried shoreline. Second, Tchula and Poverty Point sites occur

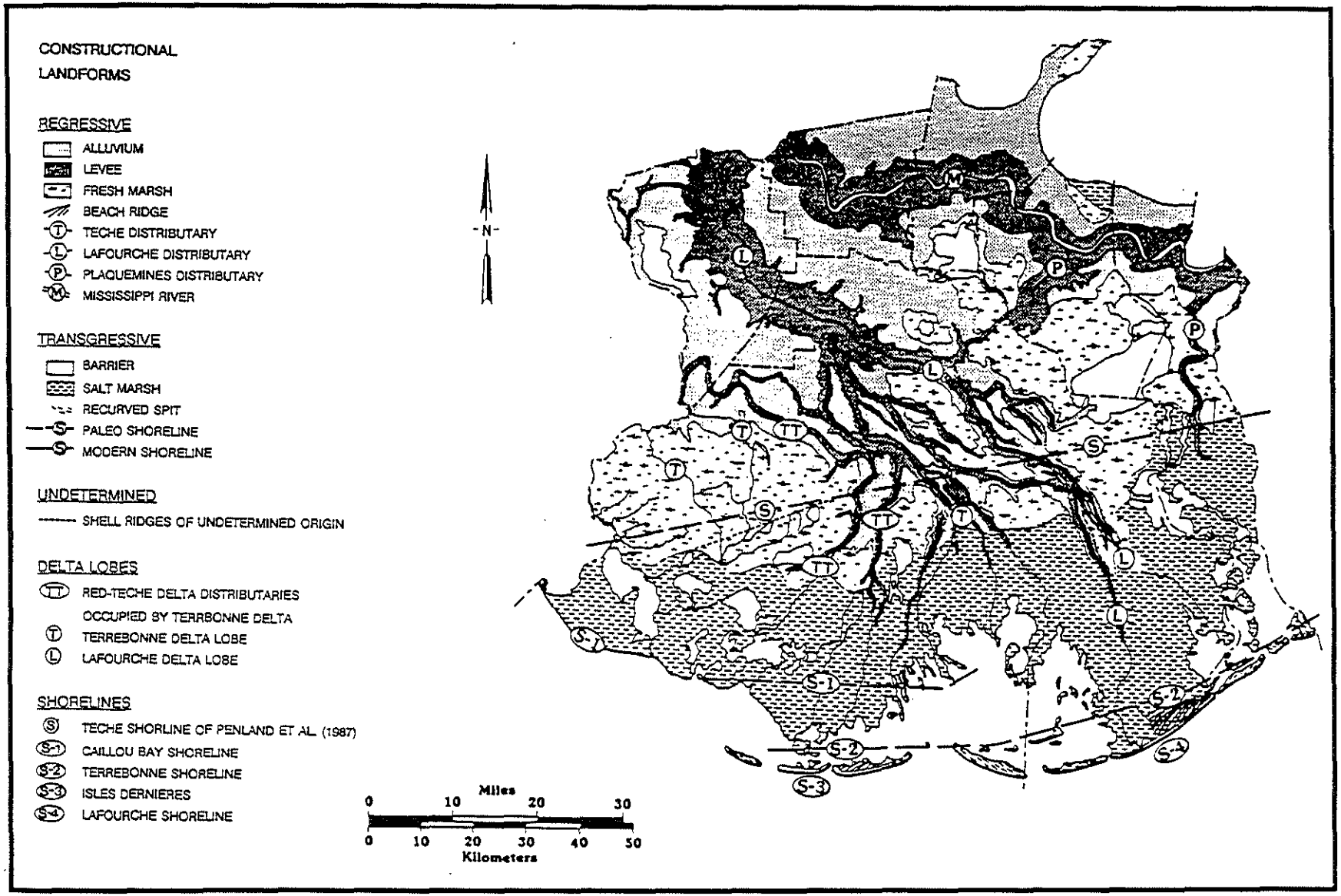
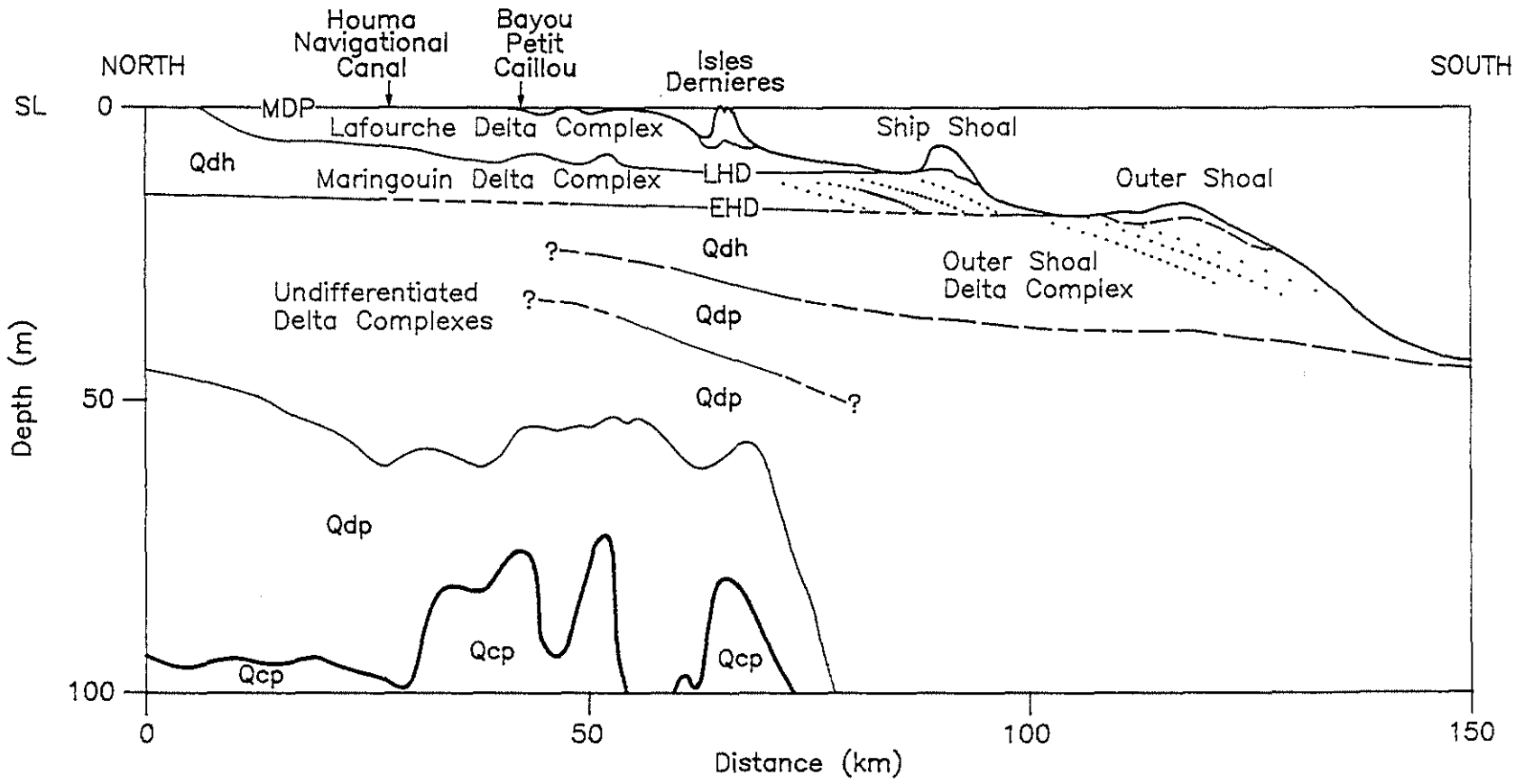


Figure 15. Geomorphology of Terrebonne Coastal Region. Modified from Penland et al. (1987).



Qdh	Holocene Delta Complexes	MDP	Modern Delta Plain*
Qdp	Pleistocene Delta Complexes	LHD	Late Holocene Delta Plain*
Qcp	Prairie Complex Sediments	EHD	Earlier Holocene Delta Plain*
. . . .	Seismic Reflections		
——	Weathered Unconformity		*Informal Terminology of Penland et al. (1987)
——	Bounding Discontinuity		

Figure 16. Cross section of Terrebonne Coastal Region. Modified from Boyd et al. (1988).

on submerged and intact distributary ridges that extend 20 to 30 km southeast of the "Teche Shoreline." These sites strongly indicate that, within the western part of the Terrebonne Coastal Ridge, the reoccupation of Teche delta distributaries by Lafourche delta distributaries has sedimentologically welded both delta complexes together. Finally, shells from the ravinement surface with radiocarbon dates of 5930 and 6682 B.P. demonstrate the cutting of this erosion into sediments of the Maringouin Delta Complex rather than those of the Teche Delta Complex.

If the "Late Holocene Delta Plain" forms the surface of the Maringouin Delta Complex, then the associated Paleo-Indian and Archaic sites probably were destroyed by the formation of the so-called "Teche" ravinement surface. Deeply buried Tchula and Poverty Point sites should be present within the western part of the Terrebonne Coastal Region.

St. Mary Coastal Region

The St. Mary Coastal Region consists of a narrow strip of delta plain that lies against the Prairie Terrace. Its coastline is characterized by deep embayments of Vermillion and Cote Blanche Bays. These bays are defined by passes formed by prominent points of land which protrude into the water between the coast and Marsh Island. Adjacent to the Prairie Terrace, the St. Mary Coastal Region is covered by freshwater marsh. However, brackish-water marsh, and a narrow band of salt water marsh situated along the coastline, covers the rest of this region (Coleman 1966b).

The St. Mary Coastal Region is the subaerial portion of the partially submerged delta plain of the Teche Delta Complex. The prominent points of land, Point Chevreul and Point Cypremont, are respectively formed by the natural levees of Bayou Cypremont and Bayou Sale. Both bayous are feeder channels of different deltas of the Teche Delta Complex. At each point, shoreline erosion is actively destroying the natural levees and archeological sites associated with them (Coleman 1966b).

The delta plain of the St. Mary Coastal Region is underlain by deposits of the Teche Delta Complex, which consist of alternating beds of peat and deltaic sediments (Figure 17). The deltaic sediments record the periodic deposition of deltaic sediments by both the Teche and Maringouin Delta Complexes, and accumulation of peats within interdistributary bays. During periods of inactivity when the delta plain was covered by marsh, a blanket of peat accumulated across the subsiding delta plain (Coleman 1966b).

Within the St. Mary Coastal Region, the diapiric movement of salt formed three islands with over ten m of relief within an otherwise flat deltaic plain. These islands are landforms that are especially attractive for habitation, because they not only provide elevated, stable terrain, but also, in some instances, saline springs. The islands generally consist of highly dissected loess-covered hills cored by uplifted Late Quaternary fluvial sediments (Autin 1984).

not found elsewhere within the coastal marshes and deltas. faunal and floral resources (litter)

The Chenier Plain

Cheniers form by the erosion of mudflats which have accumulated since the last period of shoreline erosion. During this process, shell and some sand is winnowed from the mudflats and dumped on the subaerial edge of the eroding shoreline by overwash processes. As the shoreline is eroded, this material is continually reeroded and redeposited by storm events as the shoreline cuts back into the mudflat. A permanent chenier forms only the shoreline erosion and its resulting landward migration stops, leaving a thin ridge of shell and sand overlying marsh or mudflat deposits, or a "chenier" (Penland and Suter 1989). Currently, the beach ridges and mudflats within the Chenier Plain are largely relict features. As a result, landward of the banks of rivers and the shores of lakes and bays, and the gulf coastline, the archeological deposits on the Chenier Plain have been undisturbed by natural processes since their formation, except for pedogensis and hurricanes. Storm surges generated by major hurricanes infrequently scour the Chenier Plain and cause extensive shoreline erosion (Morton and Nummedal 1983). However, relative to the effect

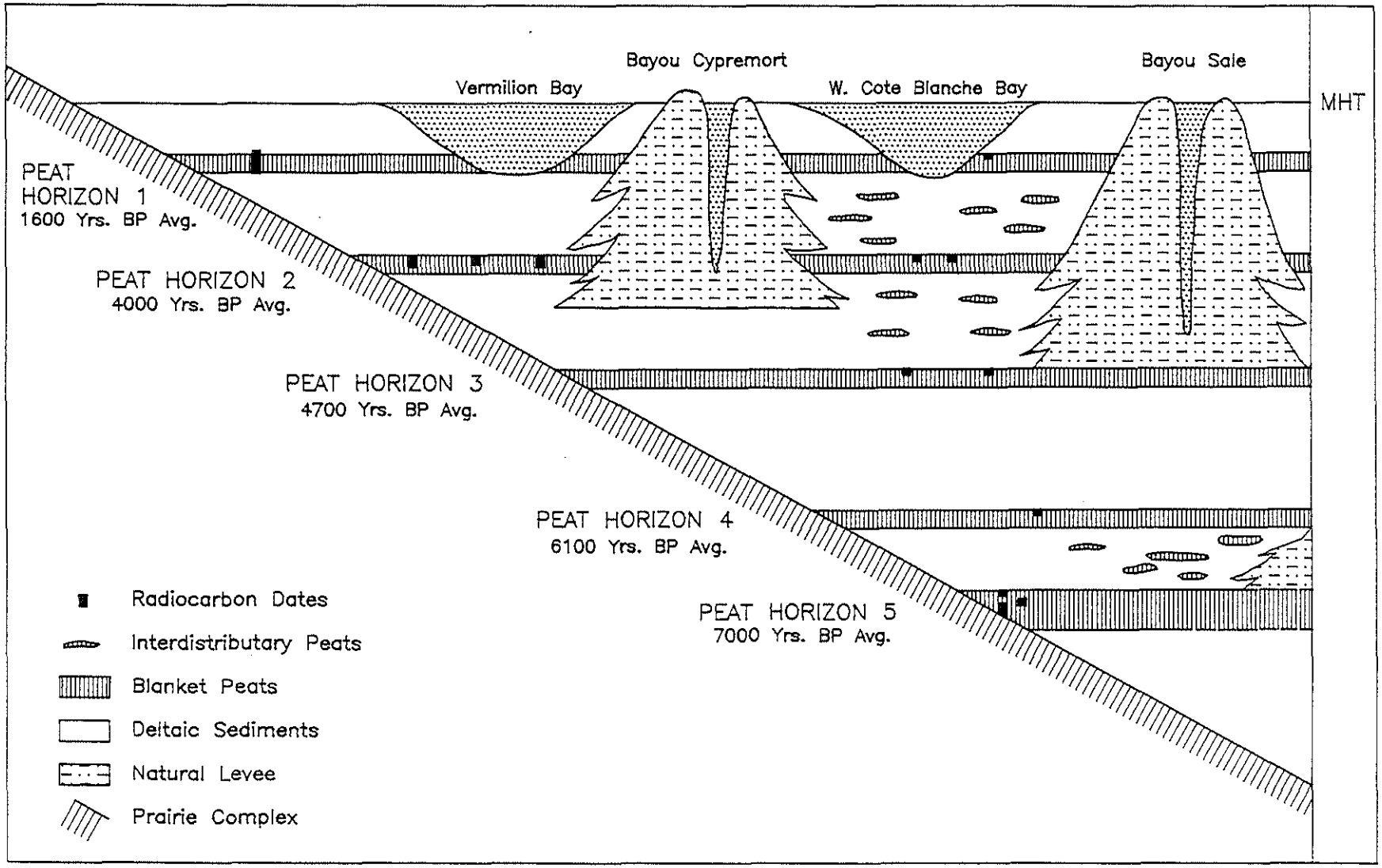


Figure 17. Schematic stratigraphic cross section of St. Mary Coastal Region. Modified from Coleman (1966b).

that historic development has had on the archeological deposits of the Chenier Plain, the effect of storm surges probably is insignificant.

There has been some controversy about the age of the Pecan Island Trend (Gagliano 1977:247-249; Neuman 1984:116-117). Because the Pecan Island Trend is the most landward and, hence, the oldest ridge complex within the Chenier Plain, its age indicates the maximum age of the Chenier Plain. As discussed in Chapter II, Gagliano (1967) claims that a Late Archaic component, called the "Copell Phase," occurs at the Copell Site. The occurrence of a Late Archaic site would indicate that the site and the cheniers of the Pecan Island Trend predate about 3500 B. P. Gagliano considered this site to be Late Archaic, only because of the lack of pottery and undescribed " . . . recent data that verifies this interpretation." However, both Ford and Quimby (1945) and Neuman (1984:116-117) assigned this site to the Tchefuncte culture because of its association with artifacts, and because of the physical anthropology of the burials recovered. Therefore, until diagnostic Late Archaic artifacts or unequivocal radiocarbon dates from this island are documented, the Copell Site should be considered a Tchefuncte site.

Furthermore, Gagliano (1977:249) notes that " . . . scattered Paleo-Indian points have been reported from Pecan Island." Unfortunately, Gagliano (1977:249) and all later investigators have failed to document the identity and archeological and geomorphic context of these artifacts. These artifacts could have been transported in either by the inhabitants or by visitors to Pecan Island belonging to post-Tchefuncte cultures. Finally, these artifacts also might have been reworked onto the chenier by shoreface processes which built it by the erosion of a deeply buried site. At both the McFaddin Beach and Sergeant Beach sites in Texas, shoreface erosion has actively redeposited Paleo-Indian artifacts on transgressive chenier-like beaches from offshore archeological deposits, as documented by Gagliano (1977:208-210). Because of the possible explanations for their occurrences, the report of the presence of Paleo-Indian artifacts on Pecan Island is too ambiguous and equivocal to constrain the age of the Chenier Plain.

Studies by Penland (1990), Penland and Suter (1985), Suter et al. (1987), and others demonstrate that the Pecan Island Trend formed long after the occupation of the coastal zone by Paleo-Indians. These studies are based upon over a hundred subsurface borings, tens of radiocarbon dates, thousands of kilometers of seismic lines, and modern sea level data. These studies demonstrate that the Pecan Island Trend formed around 2900 - 2400 B.P. (Autin, Burns et al. 1990).

Thus, vague and undocumented reports of scattered Paleo-Indian artifacts fail to provide sufficient evidence that the Pecan Island Trend formed before 2900 - 2400 B.P., prior to the occupation of the Chenier Plain by Tchefuncte Cultures (Penland and Suter 1985; Penland 1990: 84-98). Therefore, current research indicates that the formation of the Pecan Island Trend and of the entire Chenier Plain postdates the occupation of this area by both Meso- and Paleo-Indian Cultures. The Meso- and Paleo-Indian archeological deposits that occur within the Chenier Plain very likely lie on the portions of the underlying Prairie Terrace that have survived shoreface erosion (Figure 10).

CHAPTER V

GEOARCHEOLOGY

by Paul V. Heinrich

The Prairie Terrace

As discussed in Chapter IV, most of the coastal zone is a geomorphically dynamic system of fluvial and deltaic processes. The Prairie Terrace contrasts greatly in two important manners with the active deltaic, fluvial, and chenier plain systems that comprise most of the Coastal Plain. First, the Prairie Terrace is a landscape composed of relict landforms. With the exception of valleys of the streams and small rivers that cross the Prairie Terrace, and the natural levees, and of former backswamps, delta distributaries, and barrier islands that form its surface, the Prairie Terrace has ceased to migrate or grow for the last twenty thousand years. As a result, the Prairie Terrace ~~is a static landscape that, prior to the development of its surface for agriculture, changed little during the period of time it was occupied by man~~ has started to evolved into a erosional landscape with cessation of the coastal process. Within the Prairie Terrace, archeological deposits have been found on a variety of landforms. The most popular location appears to have been an escarpment bordering either an active stream, a marine estuary, or the floodplain of a river. Archeological deposits commonly occur upon pimple mounds or sand ridges adjacent to the floodplain of an active stream or to marshes of the Chenier Plain. Within the uplands of the Prairie Terrace, archeological deposits have been found on the relict natural levees of ancient Red and Mississippi River courses. Finally, numerous archeological deposits can be found within the Holocene floodplains of the rivers that have entrenched into the Prairie Terrace.

Terrace Scarps

Archeological deposits of a wide variety of cultural affiliations occur on the scarps found both within and along the edges of the Prairie Terrace. Within the Prairie Terrace, archeological deposits occur upon poorly-defined to very well-developed scarps that overlooked bayous and small streams. These archeological deposits vary in nature from single-component lithic scatters to multicomponent earth middens. Early Archaic or Late Paleo-Indian cultures typically are the sole component represented at these sites, e.g. the Jones Creek (16EBR13), Palmer (16EBR26), and Blue Bayou sites (16AL1) (Gagliano 1963:112; Gagliano et al. 1982:43-45).

River Valleys

Within both the Western and Eastern Terraces, the Prairie Terrace forms the edge of a river valley wall, such as either the Mississippi or Amite River. These areas were heavily occupied. For example, within the Florida Parishes, terrace surfaces adjacent to the scarps that formed the valley walls of the Amite River Valley were occupied by Middle Archaic cultures (Gagliano 1963:112). Also, within South-Central Louisiana, the valley wall of the Mississippi Alluvial Valley along the Vermilion River was intensively occupied by Tchefuncte cultures (Gibson, 1976b:85). Because of a lack of data, the reasons that these locations were occupied is unknown. Presumably, they represent dry and comfortable areas from which both upland and alluvial plain environments could have been exploited. Gagliano (1977:237) claims that lithic resources were given significant consideration in choosing a site location within the Amite River Valley. Prehistoric cultures also preferred the edges of the Prairie Terrace that formed the walls of valleys flooded by estuaries. Examples of such sites include *Rangia* shell middens on the valley of the Mississippi River Valley south of Baton Rouge, various Neo-Indian sites on bluffs and valley walls of the Mermentau and Calcasieu Rivers, and major Poverty Point sites on the eastern valley wall of the Pearl River. The common characteristic of all of these sites is that they occur where the high bank of the valley wall once formed the shoreline of an open body of water within an estuary (Gagliano et al. 1963:114-116; Gibson 1975, 1976a; Gagliano et al. 1982:39).

Pimple Mounds

Prehistoric people also used the pimple mounds located adjacent to either the floodplains of bayous or the marshes of the Chenier Plain as special purpose sites. Bonnin (1972) notes that archeological deposits of unspecified cultural affiliation commonly were present on pimple mounds adjacent to streams within Jefferson Davis Parish. Coles Creek cultures apparently utilized the pimple mounds adjacent to the marshes of the Chenier Plain within Vermilion Parish for special function sites (Jones and Shuman 1988a). Finally, Coastal Environments Inc. (1979a) reported on a pimple mound adjacent to an unnamed, swampy bayou within St. Landry Parish. Pimple mounds apparently provided well-drained, elevated landforms strategically situated adjacent to marshes and streams. They probably were occupied because they could be used to exploit the nearby marsh or floodplain habitats (Bonnin 1972).

Relict Natural Levees

Within the Western Prairie Terrace, Early Archaic and Paleo-Indian sites have been found on the relict natural levees of the ancient Red and Mississippi River channels and their crevasse distributaries. These sites typically consist of lithic scatters of various sizes. Neo-Indian sites within the same area apparently are scattered within the former backswamps which are now hardwood bottomlands. At this time, it is still difficult to explain the distribution of both types of sites (Coastal Environments Inc. 1979a, 1979b; Gagliano 1977).

Alluvial Valley

Archeological deposits are abundant within the alluvial plain of the larger river valleys that cut across the Prairie Terrace. With the exception of the Amite River Valley, the distribution of archeological resources and geomorphology within these valleys are largely unstudied. As a result, only the distribution of archeological deposits within the Amite River Valley can be discussed in detail. The valley's alluvial surfaces contain an abundance of archeological deposits consisting predominantly of Coles Creek culture settlements that centered around isolated homesteads, hamlets, and small villages. Almost no Plaquemine ceramics have been found, although a small quantity of late Mississippian material has been found (Weinstein 1974). Studies by Jones and Shuman (1986, 1988b) of mound sites within the Amite River Basin found that they were associated with a range of cultures, from Poverty Point through Plaquemine, with most representing Coles Creek cultures. Almost all the mounds studied occurred upon terraces or natural levees near flowing waterways, often at the confluence of streams. Typically, the mounds were constructed in areas free of frequent flooding (Goodwin, Hinks et al. 1990). Within the Amite River Valley, fluvial processes restrict the occurrence of in situ archeological deposits to the overbank deposits that form the upper portion of each alloformation. In situ archeological deposits will be lacking from the coarse-grained point bar sediments, because the formation of a coarse-grained point bar would prevent the preservation of in situ archeological deposits. Archeological deposits may accumulate on such point bars only when they are subaerially exposed between floods. However, flooding intensively reworks the surface and sediments of a coarse-grained point bar through migration of chutes and bedforms. As a result, archeological deposits can be preserved only when the point bar is abandoned and overbank sedimentation commences (Autin and Fontana 1980).

Allostratigraphy and Archeology

Theoretically, the age of each of the alloformations within the Amite River Valley limits the temporal range of in situ archeological deposits found on and within their overbank deposits. First, overbank sediments of the Magnolia Bend Alloformation will only contain archeological deposits that range in age from Late Holocene to the present. Second, overbank sediments of the Denham Spring Alloformation should contain only archeological deposits that range in age from Middle Holocene to the present. In contrast, the overbank sediments of the Watson Alloformation will contain only archeological deposits that range in age

from Early Holocene to the present. Although the recent, detailed geomorphological mapping, e.g. Autin (1989), and the compilation of data concerning the distribution of archeological deposits within the Amite River Valley will enable a test of the above hypothesis, that exercise has yet to be conducted.

Limitations concerning the age and distribution of archeological deposits within the alluvium of the Amite River indicate the need to revise interpretations pertaining to the integrity of sites within the Amite River Valley. For example, Gagliano (1963:123-124; 1977:237-240) reported the occurrence of in situ Archaic artifacts at about 5 m below the surface of the Amite River. The manganese-coated sands and gravels from which the artifacts came appear to be coarse-grained point bar deposits. Because of the manner in which coarse-grained point bar deposits accumulate (Autin and Fontana 1980), it is highly unlikely that these artifacts came from in situ archeological deposits. The erosional surface between the manganese-coated sand and gravels and overlying cross-bedded sands and gravels probably is either a basal erosional unconformity or a facies break that separates alloformations of different ages. Therefore, the model for the distribution of buried archeological deposits developed by Gagliano (1977:205-207) for the Belclair Site (41BE2) is considered to be inapplicable to the Amite River within the Watson Alloformation.

In addition, the model for the distribution of buried archeological deposits developed by Gagliano (1977:205-207) for the Belclair Site (41BE2) is ambiguous, and should not be uncritically applied to any of the valley fills of the Louisiana Coastal Zone. Because readily apparent paleosols, erosional surfaces, or other unconformities are lacking between the gravel, sand, and silt strata at this site, two different interpretations can be made. First, as interpreted by Gagliano (1977), the Belclair Terrace is formed by two stratigraphic units, consisting of a lower, Early Holocene gravel containing Paleo-Indian artifacts overlain by upper, Middle Holocene silt and sand layers containing Archaic artifacts. However, Sellards (1940) fails to indicate any obvious erosional unconformity between the gravels and sands, which apparently is an arbitrary division of a gradational contact. Therefore, the sedimentary sequence at the Belclair Site can also be interpreted as a single fining-upward fluvial sequence with redeposited Paleo-Indian artifacts within the basal point bar deposits and in situ Archaic artifacts in overbank sediments. Before this site can be used as a model for fluvial sites anywhere, the ambiguous nature of the geology of this site needs to be resolved.

Historic Disturbance

The use of the Prairie Terrace for roads, cities, and a variety of other uses has destroyed many archeological deposits. Near cities such as Baton Rouge, the increasing use of land for residential developments and road construction has severely impacted archeological deposits. The preference for building houses along bayous, and the associated landscaping of the banks and edges of the bayou, has severely impacted archeological deposits (Goodwin, Hinks et al. 1990, 1991).

Rice farming has severely disturbed most of the Western Prairie Terrace. The degree of disturbance depends upon the method by which a rice field was terraced. In some fields, terraces are formed simply by the addition of levees. The levee is diced from a narrow strip immediately upslope. In addition, the surface of the ground is disturbed by repeated plowing 10 to 16 cm deep, and by wheels of heavy machinery. Other rice fields are physically leveled by hand or by machinery, through a method called "water leveling". Dirt is taken from the higher side of a levied strip and used to fill in the lower side, until the entire strip is level. The "water leveling" method results in considerable lateral and vertical disturbance of archeological sites (Mr. Bob Williams, USDA Soil Conservation Service, personal communication 1984). Finally, the extensive network of drainage canals and ditches required by rice farming for draining and flooding rice fields would destroy or damage severely any cultural resources upon which they were built (Goodwin, Hinks et al. 1991).

The surface of the Prairie Terrace also has been altered by channelization of bayous and other small streams. Because the surface of the Prairie Terrace is flat and poorly drained, the drainages have been extensively channelized to increase drainage. This channelization has disturbed or destroyed sites lying

along the low scarps that often form their banks (Coastal Environments Inc. 1979a, 1979b; Goodwin, Hinks et al. 1990).

Historic development also has considerably impacted the river valleys. Channelization, artificial cutoffs, and flood control projects have extensively damaged archeological deposits within the small river valleys. The smaller waterways within these river valleys have been extensively altered for navigation, drainage, and flood control. Sediment introduced into these rivers by agricultural, forestry production, and other development has buried large portions of the former floodplains and terraces (Goodwin, Hinks et al. 1990).

Archeological Geology of the Prairie Terrace

Unlike the remainder of the coastal zone, in situ archeological deposits within the Prairie Terrace will only occur upon its surface or within very local accumulations of Holocene eolian, colluvial, of fluvial sediments. The restricted occurrence of archeological deposits has its benefits. Unlike the adjacent plains of the Mississippi River and Delta, the study of settlement patterns can be more straight forward. Because sites neither are being destroyed by marine transgressions and lateral migration, nor are they being buried by deltaic and overbank sediments, the distribution of sites on the Prairie Terrace should closely reflect actual settlement patterns.

However, this restricted occurrence of archeological deposits has three serious drawbacks. First, agricultural or other modern developments on parts of the Prairie Terrace easily destroy the entire record of human occupation of the area affected. Because archeological deposits are restricted to the surface or near surface of the Prairie Terrace, even a shallow disturbance of its surface will severely impact any archeological materials that may be present. Second, well stratified, deep archeological deposits will be either lacking or extremely rare within the area of the Prairie Terrace. Because the landforms that form the surface are inactive, there is no accumulation of sediments, as on an active natural levees, to bury an occupation and separate it from future occupations with sterile strata. As a result, many of the multicomponent sites contain mixed assemblages of artifacts. Finally, because these sites lie on the surface, their archeological deposits will suffer a considerable amount of disturbance resulting from pedogenesis ~~and from any subsequent use of the area~~.

The valleys of the rivers that cross the Prairie Terrace contain an abundance of archeological deposits. With the exception of the Amite River, almost no systematic studies have been made. As previously discussed, a strong relationship between the allostratigraphy of the valleys' Holocene alluvial deposits and the occurrence and preservation of archeological deposits should be evident.

Mississippi River Alluvial Plain

Within the Mississippi River Alluvial Plain, the majority of archeological deposits, which vary from residential sites to extraction locales, occur upon or within natural levee deposits. Archeological deposits are associated with the natural levees of the active Mississippi River course, the river's abandoned courses and channels within Meander Belt No. 3, crevasse distributaries, and distributary systems situated within the Atchafalaya Basin. Within the Atchafalaya Basin, a minor, but significant number of archeological deposits occur on the lacustrine deltas, within the backswamps, and along the shoreline of Six Mile and Grand Lakes (Neuman and Servello 1976; Gibson 1978, 1982b; Smith et al. 1986; Woodiel 1980b).

Natural Levees

Within meander belts, natural levees represent the preferred area of occupation for prehistoric cultures within the Mississippi Alluvial Valley. Williams (1956:55) ~~was one of the first to realize~~ this

Russel and McIntire Griffen first + Neuman

correlation, noting that they are ". . . dry under foot the year around . . ." In general, natural levees represent the only dry land within an otherwise flooded or waterlogged alluvial plain. In addition, the well-drained, silty and sandy soils of the natural levees of the Mississippi River made natural levees prime land for agricultural establishments. Finally, their proximity to transportation routes and the limited protection they offered against floods made natural levees even more desirable for prehistoric settlement. Therefore, it is expected that the majority of archeological deposits within the Mississippi Alluvial Valley will occur upon or within natural levees, because they provide location comfort, arable land, water, and safety from hazards (Weinstein 1981:28; Guccione et al. 1988:76).

Meander Belt No. 1. Within Meander Belt No. 1, the distribution of archeological deposits is still imperfectly understood. Data from the Louisiana Division of Archaeology site files, and from Kniffen (1938) and Woodiel (1980b), indicate that transitional Coles Creek and Plaquemine sites are scattered among the natural levees along both sides of the currently active Mississippi River. These sites, which include several mounds, occur on both sides of the river, either on or near its cutbank. In one twenty mile segment, Kniffen (1938) indicates at least one site on the cutbank of each meander loop. In addition, a few scattered buried prehistoric archeological deposits have been exposed by bank erosion of the natural levee within the batture along the Mississippi River. The close association of buried or surface archeological deposits with the natural levee of an active river course contradicts the "Relict River Rule," which is both defined and discussed in this chapter.

The natural levees of crevasse distributaries were also a preferred location for prehistoric occupation and formation of archeological deposits. Archeological deposits commonly are observed on the crevasses that extend off Meander Belts No. 1 and 3, and into the Barataria and Atchafalaya Basins. For example, the Lower Vacherie Mound (16SJ2) described by Gagliano et al. (1982:24-25) is a large archeological site located on a crevasse distributary. This site, like many others, is situated at the junction of a crevasse and a smaller course, where access is allowed to the natural levees and course of the Mississippi River, and to the biologically rich swamps of the Atchafalaya Basin. Similar crevasse distributaries with sites, e.g. the Sims Site (16SC2) and the Shell Hill Plantation (16SJ2), extend from Meander Belt No. 1 into Barataria Interdistributary Bay (Duhe 1981:36-37; Beavers 1982:119; Gibson 1982b; 1990).

Meander Belt No. 3. The distribution of archeological deposits within Meander Belt No. 3 is still poorly understood. Archaic site have been found only on unnamed loess-covered terraces. It is possible that Archaic sites are present on the surface and within the overbank deposits of the Lake La Pointe Meander Belt, but they probably are buried by overbank sediments from the Bayou Teche Meander Belt.

In contrast, Tchefuncte sites have been found across all of Meander Belt No. 3. These sites occur near the crests of the outer natural levees and at their western edge adjacent to the Atchafalaya Basin. An extremely unusual concentration of Tchefuncte Sites occurs along the natural levees and terraces edges of the Vermillion River. Sites also are found associated with relict crevasse distributaries, ridge and swale topography, the Prairie Terrace, and colluvial fans. Sites dating from the Plaquemine Culture are scattered across Meander Belt No. 3, with an apparent lack of preference for any specific landform (Gibson 1976b, 1990).

Crevasse distributaries and splays that extended from Meander Belt No. 3 into adjacent swamps or marshes also provided preferred locations for prehistoric occupation. Two such sites are the Grand Avoille #1 and Grand Avoille #2 sites (16SMY12 and 16SMY13), which lie upon a partially buried distributary crevasse that extends into the Atchafalaya Basin. Generally, these relict crevasses now either are partially buried by swamp and marsh or are partially submerged by lake waters. Because these crevasses are very narrow, have very clayey soils, and lack sites that predate the Coles Creek or Troyville cultures, they apparently served solely as elevated landforms from which prehistoric inhabitants exploited the resources of nearby lakes, swamps, and marshes. Crevasses which remained open as tidal channels connecting

Bayou Teche and adjacent lakes of the Atchafalaya Basin are either bordered by numerous shell middens or have large, often continuously occupied, shell middens located at the confluence of channel and lake.

Atchafalaya Basin

Within the lower Atchafalaya Basin, most of the archeological deposits are situated on very low, narrow natural levees of bayous and partially buried crevasses. The larger sites occur at the confluence of bayous or bayous and lakes. Extraction locales and other special function sites cluster around the larger, presumably seasonal habitation sites (Neuman and Servello 1976; Gibson 1978; 1982b). Several of the bayou-lake confluence sites and natural levee sites have been incorrectly classified as lacustrine delta sites by Smith et al. (1986:Plate C2).

Sites that predate the Baytown Phase are lacking from the Atchafalaya Basin, although Tchefuncte sites have been found along its edge. This lack of Tchefuncte sites has been interpreted by Gibson (1982b) as evidence that the Tchefuncte culture failed to utilize the swamps of the Atchafalaya Basin. He suggests that it was groups from Troyville-like cultures that first "pioneered" the exploitation of the Atchafalaya Basin.

However, an alternative hypothesis suggests that the Atchafalaya Basin was not exploited by Tchefuncte cultures because most of the area was still covered primarily by interdistributary lakes (Tye 1986). The occurrence of Tchefuncte sites along the edge of this basin represents the utilization of these lacustrine resources. During the Baytown and Coles Creek periods, large portions of the lakes were converted by lacustrine deltas into swamp. As soon as these swamps formed, groups of Troyville-like and Coles Creek cultures ventured into and began to exploit the resources of the Atchafalaya Basin. Insufficient data exist at present to prove which hypothesis best explains the distribution of archeological sites within this basin. Because of the natural dynamics of this basin, which alternated between being occupied by large interdistributary lakes and by swamps, stratigraphic analyses of sedimentary processes will play an important role in reflecting the temporal distribution of archeological resources throughout the area.

Natural Levee Processes

As a natural levee grows, it rises in elevation relative to bankfull stage, thereby decreasing the frequency of flooding. As a result, higher flood levels are required to submerge the natural levee. If the adjacent channel is stable, a natural levee will reach a height such that it will stay almost permanently dry, since all but the most severe floods are channeled through crevasse channels, rather than over the levee crests (Fisk 1947; Farrell 1989).

The growth of a natural levee will affect sedimentation rates and the preservation of cultural resources because it changes the frequency of flooding. The higher the natural levee becomes, the less frequently it is submerged by flooding. The drop in the frequency of flooding drastically lowers the rate of sediment accumulation. Changes in the rate of sediment accumulation causes modifications in the preservation of spatial patterning, artifact density, superpositioning of occupations or features, and the effects of pedogenesis and local scouring (Ferring,1986:271; Farrell 1990).

For example, from work at the Bruly St. Martin site (16IV6), Springer (1973, 1974) concluded that changes in the frequency of flooding can dictate the manner in which a natural levee is utilized. Based on the upward increase in artifact density, on the degree of midden development, and on the lack of structures in the associated archeological deposits, Springer concluded that the use of the site changed as the levee grew. Initially, the Coles Creeks inhabitants used the natural levee as a seasonal camp. Later, the growth of the natural levee decreased the frequency and severity of flooding sufficiently to allow the formation of a permanent settlement (Springer 1973:2, 1974:78).

However, Springer's observations at the Bruly St. Martin site also can be explained by a change in sedimentation rates. A decrease in the overall rate of sedimentation and frequency of sedimentation events as the natural levee grew would create an apparent increase in artifact density and midden development (Ferring 1986:271). Because of the limited area excavated, the absence of structures within the lower levels of this site is uncertain. In fact, it seems strange that the function of the site would change without appreciable change in the faunal, floral, and artifact subassemblages. Therefore, it remains unclear whether the changes seen at this site reflect cultural or natural processes, or a combination of both.

Obviously, natural processes within the Mississippi Alluvial Plain greatly affect the interpretation of the cultural record, not only in the interpretation of site distributions, but also on the scale of the individual site. At the survey level, it is readily apparent that the lateral migration of river channels and the aggradation of natural levees severely bias the preservation and surface distribution of archeological deposits. Also, changes in the frequency and severity of flooding as a natural levee grows greatly predict how the site was used and how well the resulting archeological deposits were preserved. Unfortunately, much remains to be learned about how fluvial processes constrain the original use and distort the resulting archeological record within meander belts. In studies of both large areas and individual sites in a meander belt setting, an analysis of the geomorphology and sedimentology represents a necessary part in interpreting the archeological record.

Relict Channel Rule

Whether a river channel or course was active or abandoned might determine the use and type of settlements found on natural levees. Pearson (1982) and Weinstein et al. (1979) note what Weinstein and Kelley (1989) call the "relict channel rule," which assumes that sites found on the natural levees of channels were established after a specific channel was abandoned, i.e., became a relict channel. They speculate that the lack of rich biotic resources associated with an active channel and the hazards created by periodic flooding greatly discouraged prehistoric settlement along natural levees of active river courses. For example, Pearson (1982) speculates that the danger posed by rapidly eroding cut banks was an additional factor discouraging settlement along active Red River channels. On the other hand, Weinstein et al. (1979) and Pearson (1982) propose that relict river channels occupied by oxbow lakes were preferred site locations for prehistoric settlements, since these locales represent areas of rich biotic resources and of reduced flooding.

Weinstein (1981) clearly documents a shift in settlement along the bankline of an oxbow lake, at Swan Lake, in Mississippi. He suggests that the village sites were moved routinely in order to efficiently exploit biological resources as the lake filled. Eventually, however, the lake filled with clastics and organic material and declined severely in biological productivity. After that time, no new sites were established along the cutoff meander loop, and the major habitation sites degenerate into special activity areas. New habitation sites were then reestablished at a newer Mississippi river cutoff (Weinstein 1981).

The active lateral migration of the Mississippi River can also explain the lack of surficial archeological deposits which predate the abandonment of a river channel or course segment. While active, a typical Mississippi River channel rapidly migrates back and forth across its meander belt. This activity would bury any archeological deposits that formed adjacent to an active point bar. Conversely, an actively, laterally-migrating channel would consume any sites located on or present within a natural levee or its cutbank. If a Mississippi River cutbank migrated up to and stopped at a preexisting site, that site would be buried beneath natural levee deposits. As a result, only those archeological deposits that date several decades prior to and that postdate the abandonment of the channel will occur as surface sites. Therefore, regardless of whether the natural levees of an actively meandering stream were used before or after the abandonment of a particular river channel or course segment, the same distribution of surface sites expressed as the Relict Channel Rule will result.

Because of the lack of deep testing of natural levees, precise data on the occurrence of buried sites that may predate abandonment of a channel or course are lacking. As a result, the data needed to test the Relict Channel Rule and the alternative hypothesis are lacking. In order to test this hypothesis, deep and systematic testing for buried sites, and determination of age and stratigraphy of natural levee deposits, needs to be conducted.

Existing data does indicate that, contrary to Pearson (1982) and Weinstein (1981), the Relict Channel Rule reflects sedimentological rather than cultural processes, because flooding associated with an active course or channel fails to discourage occupation of the natural levees. First, detailed work by White et al. (1990:28) within the American Bottoms in Illinois found that the natural levees and point bar ridges of Mississippi River channels first were occupied both prior to and for a significant period of time after the associated channels were abandoned. Second, excavations by Springer (1973; 1974) of buried archeological deposits at the Bruly St. Martin site demonstrate that seasonal flooding of levees associated with a distributary crevasse restricted, but failed to discourage, their occupation. Third, the presence of scattered surficial and buried prehistoric archeological deposits within the natural levees of the current course of the Mississippi River further demonstrate that such sites were continually occupied, despite the river's activity (Woodiel 1980b). In addition, Giardino (1984) documents numerous historic Indian settlements along the natural levees of an active Mississippi River. Finally, Guccione et al. (1988:81-83) clearly show that any alluvial plain rich in faunal and floral resources will be exploited, despite the temporary inconvenience of flooding.

Colluvial and Alluvial Fans

Numerous colluvial and alluvial fans occur along the valley walls of the Mississippi River Alluvial Plain. At this time, prehistoric archeological deposits have not been found in association with any of these colluvial fans. However, elsewhere in the Mississippi and in other river valleys, colluvial and alluvial fans have proved to contain multiple buried archeological deposits possessing excellent integrity (Hajic 1987; White et al. 1990:24, 27). The colluvial and alluvial fans, especially those along the western valley wall of the Mississippi River Alluvial Plain, have an excellent potential for containing deep, well-stratified archeological sites. The geomorphology of these fans suggests that these deposits may contain well-preserved Paleo-Indian and Archaic period components.

Lake Shore Sites

Within the Atchafalaya Basin, numerous sites associated with the shoreline of Grand Lake have been recorded (Neuman and Servello 1976; Gibson 1978, 1982b). Most of these sites belong to one of two groups of sites. The first group of sites consists of shell middens that lie at the edge of Grand Lake where the shoreline is formed by the distal edge of the relict outer natural levee of the Teche-Mississippi River. Along this edge, a thin veneer of both swamp and historic terrigenous deposits cover the relict natural levee. Sites occur both on relict distributaries that extend into the swamp or lake, and along the partially buried edge of the relict Teche-Mississippi natural levee. Typical examples of these types of lake shore sites are 16SMY37, 16SMY113, 16SMY114, and 16SMY163. The other main type of lake shore site consists of sites located along the Grand Lake shoreline, which has been formed by backswamp. Typically, such sites lie at the confluence of a bayou with the shoreline of Grand Lake. Typical examples of this type of site, all of which have been buried by historic sedimentation, are 16IB05, 16IB45, and 16IB46. As noted by Smith et al. (1986:74), the occurrence of Coles Creek and Tchefuncte components within several lake shore sites indicates that prior to the diversion of Mississippi River flow into the Atchafalaya River, the shorelines of Grand Lake had been stable for centuries.

Lacustrine Delta Sites

Within the Atchafalaya Basin, Smith et al. (1986) lists nine sites on lacustrine deltas. However, careful examination of historic maps; historic Soil Conservation Service aerial photography; plates presented within Fisk (1952); original site descriptions; Division of Archeology site files; soils surveys; Tye (1986); and, of studies by Neuman and Servello (1976), demonstrate that none of these sites are associated with lacustrine delta deposits (Smith et al. 1986:Plates 22 and 23). Rather, these sites lie upon landforms that have been buried since 1935 by overbank sedimentation associated with the infilling of Grand Lake by lacustrine deltas. In fact, mapping within the immediate vicinity of each site is misleading, since overbank sedimentation, rather than the infilling of Grand Lakes by lacustrine deltas, has buried the majority, if not all, of these archeological deposits (Tye 1986).

These so-called "lacustrine sites" are representative of the different types of sites normally found within the Atchafalaya Basin prior to their burial by the historic influx of sediment that came down the Atchafalaya River. Two shell middens, 16SMY43 and 16lB10, were found upon the banks of small bayous. Two other shell middens, 16lB43 and 16lB44, occurred on islands that existed within Grand Lake prior to the formation of any lacustrine deltas. The remaining five sites all were found at the confluence of bayous and the shoreline of Grand Lake (Neuman and Servello 1976).

The association of most of these and other sites with either islands or the shoreline of Grand Lake strongly supports two conclusions of Smith et al. (1986:74). First, the association indicates that the shorelines of lakes within the Atchafalaya Basin were important areas of resource exploitation. Second, the association documents the stability of shorelines associated with Grand Lake; apparently the shoreline was stable for centuries prior to the diversion of the Mississippi River into the Atchafalaya River.

Backswamp Sites

Smith et al. (1986:Plate 3C) classify three sites, 16lB4, 16lB6, and 16lB13, as backswamp sites. Descriptions of these sites reveal that they occur on the banks or natural levees of small bayous; this pattern is typical of many sites within the Atchafalaya Basin. Two sites (161B4 and 161B6) have been completely or partially buried by recent overbank sedimentation. The final site (161B13) has not been reencountered since its first description. Sites 16lB10 and 16SMY43 represent backswamp sites which have been buried by recent overbank sedimentation associated with the historic filling of Grand Lake (Fisk 1952; Neuman and Servello 1976).

Historic Impacts

Within the coastal zone, historic use of Mississippi River meander belts and crevasses has severely impacted the archeological deposits associated with these features. Agricultural, urban, and industrial development extensively disturbed large portions of the natural levees and point bars within meander belts of the Mississippi River. In addition, development of artificial levees for flood control along the entire length of the modern course of the Mississippi River has impacted severely archeological deposits buried within or resting upon construction surfaces.

Residential and Industrial Development. Because the natural levees of the modern and ancient courses of the Mississippi River are still the only dry land within an otherwise flooded or waterlogged alluvial plain, they have been the focus of urban and industrial development. Obviously, the construction of housing, commercial buildings, and industrial plants has directly disturbed the surface and subsurface deposits of large portions of both modern and relict Mississippi River deposits. In addition, roads, railroads, pipelines, and cables that run between towns and businesses have also disturbed large swaths of land. Undoubtedly, urban and industrial development has destroyed a significant number of archeological sites within the Mississippi River Alluvial Plain.

Agricultural Disturbance. The fertile and well-drained natural levees of the Mississippi River are ideal for agricultural use. As a result, they have been extensively developed for the production of sugar cane and rice.

In the case of sugar cane farming, the primary disturbance results from the creation of furrows or "row middles" and rows on which the cane is grown. Both the rows and row middles are 15 cm across and have a relief of 40 to 50 cm. They are formed by cutting row middles 20 to 25 cm below ground surface and by building up the associated ridges by 20 to 25 cm. Disturbance also results from deep plowing; plowing as deep as 60 cm is conducted to condition the soil by breaking up hardpans, and to improve permeability (Lytle et al. 1959; Mr. Bob Williams, USDA Soil Conservation Service, personal communications 1984). Finally, the extensive network of drainage canals and ditches needed for drainage probably destroyed or impacted severely any archeological deposits that were crossed (Goodwin, Hinks et al. 1991).

Rice farming also has severely disturbed significant portions of the Mississippi Alluvial Valley (Goodwin, Hinks et al. 1989; 1991). The effects of rice farming have been previously discussed with regard to the Prairie Terrace.

Construction of Artificial Levees. The historic construction of artificial levees to control annual flooding along the modern course of the Mississippi River severely impacts the natural levee and any archeological deposits buried within or resting on its surface. The building of artificial levees requires the digging of borrow pits; foundation preparation greatly disturbs the natural levee and associated archeological deposits. Tree stumps and roots more than an inch in diameter are removed to a depth of 2 m by methods that include blasting. In addition, a 2 m deep interception (muck) trench typically is excavated and refilled along the centerline of the artificial levee in order to disrupt the flow of groundwater. The surface of the levee is graded and filled to form a level surface on which to build the artificial levee. That surface is further grubbed and plowed to promote bonding between the natural and artificial levees. The fill used to construct the artificial levee is typically obtained from borrow pits located on the river side of the artificial levee, thereby potentially destroying or severely damaging the archeological deposits within that area. Also, the movement of heavy earthmoving and other construction machinery used to borrow dirt and to construct the artificial levee significantly disturbs areas surrounding the levee and borrow pits (Castille 1979; Goodwin, Hinks et al. 1989).

Because the artificial levee prevents overbank flooding and sediment deposition, it also prevents the natural levee from migrating with the river channel. As a result, cutbank erosion has reduced the height and width of the natural levee and has undermined the existing artificial levee numerous times. Formerly, the failure or potential failure of the artificial levee has resulted in the construction of a new levee or setback levee. Each time a new setback levee is constructed, the natural levee is repeatedly disturbed for foundation preparation and excavation of borrow pits. In addition, accelerated erosion of the natural levee within the batture erodes the natural levee and enclosed archeological deposits. Frequently, artifacts are winnowed from eroding archeological deposits and redeposited along the bankline at different levels, depending on bank stage (Castille 1979).

Excessive bank erosion that threatens an artificial levee is now restricted by the construction of revetments. Revetment construction also severely disturbs the natural levee and its associated archeological deposits. The initial phases of revetment construction require the removal of all organic debris within the ground to depths of 2 m. The bank then is graded, which often requires the removal of a few vertical meters of the natural levee. Finally, the revetment is laid and riprap is placed on the upper bank to prevent erosion from undermining the revetment (Goodwin, Hinks et al. 1989).

Navigation. Currently, within the coastal zone, both modern and abandoned courses of the Mississippi River carry substantial recreational or commercial river traffic. The use of these river courses

creates significant wave action from the wakes of this waterborne traffic. Along the Mississippi River, the wave action created from commercial ship traffic results in severe bank erosion.

Similarly, a quick examination of site descriptions from the files of the Division of Archeology indicates that bank erosion is actively destroying many of the sites located along the banks of the abandoned Mississippi River course of Bayou Beouf and Bayou Teche. The cause of this erosion is uncertain, but wakes generated by river traffic probably contributes significantly to the damage. Also, many of the sites along the southern shoreline of Grand Lake have been significantly damaged and are eroding fast. A general impression left by the review of site forms and survey reports is that, over the next ten years, much of the archeological record along the banks of this abandoned Mississippi River course will have been destroyed by bank erosion and development.

Sedimentation. The diversion of Mississippi River flow down the Atchafalaya River introduced large volumes of sediment into the Atchafalaya Basin, resulting in the infilling of Six Mile and Grand Lakes, and in the burial of numerous archeological deposits. Mounds over three m high have been completely buried by this influx of sediments (Neuman and Servello 1976).

Distribution of Archeological Deposits Within the Meander Belt

Archeological deposits within an alloformation formed by a meander belt and its deposits will be limited to its overbank sediments and its surface. The lateral migration of the channel erodes preexisting sediments and archeological deposits at the cutbank. Concurrently, the migrating channel deposits coarse-grained sediments on its point bar. Because the deposition of point bar deposits occurs primarily within the submerged channel, the point bar deposits will lack in situ archeological deposits. Archeological deposits can accumulate and be preserved only where the periodic vertical accumulation of sediments occurs on the normally subaerial natural levee (Fisk 1947).

Summary

The lateral migration of a channel within a meander belt badly biases the temporal distribution of both surficial and buried archeological deposits. First, the formation of a meander belt destroys archeological deposits that predate it. Second, the lateral migration destroys many of the archeological deposits contemporaneous with the active river course; a few deposits may be preserved along the outer edge of the meander belt. These sites are buried within or on the surface of natural levees of abandoned meander loops. Finally, archeological deposits forming after the abandonment of a river course will occur entirely as surface sites. Because of the extensive destruction and burial of sites by meander belt processes, reconstruction of settlement patterns of many cultural groups from the distribution of recorded sites can be difficult, if not impossible.

Mississippi Delta Plain

Within the Mississippi River Delta, almost all, if not all, of the archeological deposits, whether extraction locales or habitation sites, are located on elevated landforms such as natural levees, beach ridges, and salt dome islands. Natural levees represent the most commonly occupied landform, probably because they are the most abundant elevated landforms within the delta plain. Archeological deposits also are very common on salt domes and beach and shell ridges, which represent rare elevated landforms within the Mississippi Delta Plain. A small percentage of archeological deposits also have been recorded on the shores of lakes and bays, barrier islands, and swamps (Smith et al. 1986:73-75; Weinstein and Kelley 1990:109).

Natural Levees

As first observed by Kniffen (1936), the majority of archeological deposits present within the Mississippi Delta Plain are found upon subaerial or partially submerged natural levees of major bayous and rivers. Natural levees apparently represent the predominant location for human settlement and other activities on delta plains (Britsch and Smith 1989:243-244; Weinstein and Kelley 1990:109-110).

Many factors have been proposed for the preferred utilization of natural levees by the prehistoric inhabitants of the Louisiana Coastal Zone. Natural levees apparently were occupied very heavily by prehistoric cultures because they were the only common landform within a deltaic plain on which to dwell comfortably and to exploit a rich deltaic ecosystem. Also, after agriculture was established, the surface of a natural levee was the only common source of arable land available on a delta plain (Kniffen 1936; Britsch and Smith 1989:243-244; Weinstein and Kelley 1990:109-110).

However, the character of the different kinds of natural levees within the Mississippi Delta Plain significantly restricts the practice of agriculture. Narrow width, clayey soils, and shallow water tables that characterize many of the natural levees of distributaries either severely restrict or prevent the practice of agriculture. While the distributary was active, annual flooding would have made farming even more impractical. Only the broader and higher natural levees would have possessed the necessary width, coarse-grained soils, and drainage for significant agricultural production. In addition, even when the adjacent river course was active, these natural levees would have been less susceptible to flooding ~~(Penland et al. 1988)~~. Remove

Other reasons have been proposed as additional explanations for the prehistoric popularity of natural levees. Unfortunately, none of them have been specifically tested by archeological research. Some of these speculations are: (1) natural levees provided habitat for terrestrial game which was exploited as a food source; (2) they provided a source of raw materials; (3) their proximity to open water provided both subsistence and transportation; and, (4) they provided a location safe from natural hazards such as flooding and hurricane storm surge (Gagliano 1984; Britsch and Smith 1989:243-244; Weinstein and Kelley 1990:109-110).

Distribution of Sites on Natural Levees

As in the Mississippi Alluvial Plain, sites occur at specific locations along the natural levees of the river course. Sites associated with a river course typically lie near the crests of natural levees, either on the cutbank side of their abandoned meander loops or at the junction of major river distributaries. Site are also commonly located at the end of a crevasse distributary that extends from the river course (Gagliano et al. 1982:20-22).

Within the Mississippi Coastal Plain, sites are distributed in a typically north-to-south pattern along the natural levees of crevasse channels (Beavers 1977:102-106). This site distribution is pattern-linear, since the available elevated ground consists of linear landforms such as the natural levees of trunk channels and distributaries, as well as a shell ridge of uncertain origin. This pattern has been illustrated by a number of studies, e.g. McIntire (1958), Gagliano et al. (1975; 1979), Neuman (1977), and Wiseman et al. (1979).

Within this overall linear distribution of sites, the major residential site complexes are strategically situated at the confluence of distributary channels with the trunk channel of deltaic complexes (Beavers 1977; 1982). An example of this type of site, the Magnolia Mound Site (16SB49), is illustrated by Gagliano et al. (1982:20-22). This distribution pattern of major residential sites has been documented for Marksville, Coles Creek, Troyville, and Mississippian sites within the Barataria Basin and Marksville Magnolia Phase sites, along the Bayou La Loutre trunk channel of the St. Bernard Coastal Region (Beavers 1982; Wiseman et al. 1979). Within the Terrebonne Coastal Region, the Mississippian and Coles Creek major residential

sites occur on the natural levees of the abandoned Teche-Mississippi River course at the confluences of major deltaic distributaries (Weinstein and Kelley 1990).

Factors concerning comfort, transportation, and subsistence apparently determined the location of major residential sites at these confluences. The confluences might have been selected for these sites for reasons of comfort and possibly safety; they tend to have natural levees both higher and wider than normal. Also, the confluence of sluggish channels is typically the locus of freshwater fauna and flora. Finally, confluences gave local residents an easy and commanding access to the distributary system that served as "highways" for their watercraft (Beavers 1982).

Both Beavers (1982) and Gagliano (1984) agree that smaller residential sites occur on the natural levees of distributaries between the major residential sites. However, from work conducted in the Barataria Basin, Beavers (1982) attributes the location of these smaller sites to a function of social organization. He proposes that the degree to which smaller residential sites cluster around major residential sites or spread out along a natural levee varies according to the degree of social organization. Accordingly, locations of smaller residential sites reflected sociopolitical factors, because biological resources were uniformly distributed along distributaries. This uniform distribution of resources resulted in equality of access regardless of site location between confluences. In Beaver's model, the special function sites, called "extraction locales" by others, were scattered about the smaller residential sites at locations determined by the resource being exploited Beavers (1982).

According to Gagliano (1984:23, 37) and Gagliano et al. (1979), landform determined the distribution of the smaller sites located on natural levees between the confluences of tributaries. Accordingly, smaller residential sites occur at the confluence of a distributary with a crevasse splay or other distributary. In addition, natural levees at the heads of major delta lobes, the mouths of active distributaries, the banks of crevasse channels of individual subdeltas, and accretion ridges at the mouths of distributaries, were preferred locations for prehistoric settlement.

Crevasse Distributaries

Archeological deposits of various types occur on the natural levees along and at the end of large crevasse distributaries that penetrate into the Barataria Basin from the meander belt. For example, two large Mississippian residential sites, the Sims Site (16SC2) and the Shell Hill Plantation (16SJ2) lie on large crevasses that extend from the Mississippi River into the adjacent backswamp. Because of their size and the fertility of the soils on the natural levee, large crevasses were well suited for both maize farming and for hunting and gathering in the adjacent swamp. However, most crevasse sites are located on smaller crevasse distributaries and are thus either small residential sites or extraction locales. The inhabitants of these sites were restricted to the exploitation of the biological resources of the adjacent swamp (Beavers 1982:119; Duhe 1981).

Work at the Shell Hill Plantation Site (16SC2) illustrates the faunal and floral resources exploited from crevasse sites. From the crevasse and the adjacent backswamp, the inhabitants of this site subsisted upon fishes, reptiles, amphibians, mollusks, occasional land mammals, and wild plants. Although these resources were apparently supplemented by some cultivated plants, inhabitants subsisted primarily on hunting and gathering (Duhe 1981).

Beach and Shell Ridges

In addition to natural levees, other landforms chosen either for habitation or for use as extraction locales were the beach and shell ridges present within the Terrebonne Coastal Region. Although they offered a lower quality elevation and drainage than that of the natural levees, and thus could not be farmed, these landforms were still heavily used. Like natural levees, they provided a comfortable location from which

exploitation of swamps, marshes, interdistributary bogs and bays, lakes, and other deltaic environments could be performed. Because of the rarity of beach and shell ridges within the delta plains, the percentage of archeological deposits found on these landforms has been small (Brown 1984: 100; Weinstein and Kelley 1990).

A beach ridge differs significantly from a natural levee in its low potential for containing buried sites. In the case of natural levees, periodic vertical accretion during annual floods allows for extended periods of subaerial exposure and settlement. Floods only briefly interfere with the use of a natural levee, and they add sediment to the natural levee that buries any associated archeological deposits. In this manner, a thick stratified sequence of archeological deposits can form. In contrast, beach ridges form by either the mostly subaqueous lateral accretion of sand or shell along a prograding shoreline, or by the dumping of sand or shell on an eroding shoreline by overwash processes (Penland et al. 1985). In either case, as a beach ridge forms, sediments are deposited by processes that allow neither for periodic occupation nor for preservation of archeological deposits. As a result, except for dune sands or middens that may cap them, beach ridges have little potential for deeply stratified sequences of archeological deposits. Sites found on beach ridges will be surface sites, unless buried by eolian or human agencies.

Shell Ridges. Within the Terrebonne Coastal Region, numerous archeological deposits lie upon the Bayou Perchant Shell Ridge. Numerous shell middens containing Marksville to Mississippian components have accumulated upon the individual islands that are the subaerially exposed portions of this ridge. In addition, two of these islands contain Coles Creek shell mounds (Kelley and Weinstein 1990). As discussed in Chapter IV, the Bayou Perchant Shell Ridge of uncertain origin. The origins of both the Deer Island and the Bayou Perchant Shell Ridges are interesting to archeologists for reasons other than a general understanding of the chronology of delta formation. For both the Deer Island and the Bayou Perchant Shell Ridges represent beach ridges, then the potential for encountering a deeply stratified sequence of occupations is almost nonexistent. However, if these shell ridges represent middens, then these sites could be very valuable, deeply-stratified multicomponent sites.

Barrier Islands. Within the St. Bernard Coastal Region, archeological deposits lie upon the beach ridges of the New Orleans and Hancock-Sauvage Barrier Island Trends (Figure 17). Delta progradation completely engulfed the New Orleans and Hancock Barrier Island Trends, by 3900 and 2600 years B.P., respectively. Thus, when the Tchefuncte cultures first occupied both of these barrier island trends, they represented relict landforms. As a result, the barrier islands were probably settled, because they too were elevated landforms on which people could dwell comfortably and could exploit the adjacent rich deltaic ecosystem. Although both barrier trends were inactive when groups of Poverty Point cultures occupied the adjacent natural levees and shoreline, it is curious that Poverty Point components and sites are lacking from both relict barrier islands trends (Saucier 1963; Otvos 1975:159).

Both Gagliano et al. (1979:Figure 2-26) and Gagliano (1984:37) somewhat misleadingly identify transgressive barriers as one of several "preferred" locations for archeological deposits. On the contrary, as their discussions demonstrate, natural, not cultural, processes deposited the cultural material found on the beaches of active barrier islands. Technically, these are neither archeological deposits or sites. The artifacts found at "sites" such as the Isle au Pitre and South Island sites (16SB22 and 16SB24) on the Chandeleur Islands consist of materials eroded from the underlying delta deposits and subsequently redeposited on the beach (Gagliano et al. 1979; Gagliano 1984).

Salt Domes

A variety of archeological deposits have been found in association with salt domes. Typically, these deposits consist of surface scatters situated along the periphery of these islands. Within the uplands, the surface scatters have been found to cluster around the edges of old ponds and marshy areas. The bayous, bays, and lakes around the margins of salt domes frequently are associated with large archeological

deposits. The Morton Shell Mound Site (16IB3) is an example of one such site (Brown 1980; Gagliano et al. 1982; Autin 1984). Another unique site is the Salt Mine Valley Site (161B23), a solution valley on Avery Island filled with colluvial and alluvial sediments that contain deeply buried archeological deposits. Abundant Pleistocene faunal remains have been recovered at the base of these sediments. The cultural remains range in age from Archaic and perhaps Paleo-Indian to Mississippian. The abundance of ceramic salt drying pans suggests that this site was an important source of salt for both the Plaquemine and Mississippian cultures (Brown 1980; Neuman 1984).

Shores of Lakes and Bays

Many of the shell middens recorded along the shores of bays and lakes actually represent modern transgressive beach deposits. Shells, pottery, and other artifacts found at these sites originally were associated with archeological deposits on or within buried natural levees of a deltaic distributary. As the shoreline moved inland, the natural levee and its archeological deposits were eroded and redeposited as a thin, transgressive beach. With continued erosion of the shoreline, reworked shells and other artifacts can migrate substantial distances from original site positions. This process has been observed and documented by a number of researchers, e.g. Treadwell (1955), McIntire (1958:8), Wiseman et al. (1979:4-2,5-13), Gagliano (1984:28), Britsch and Smith (1989:246), and Weinstein and Kelley (1990).

For example, Weinstein and Kelley (1990) note that many of the recorded "shell middens" fringing the shoreline of Fourleague Bay consist of wave-washed and redeposited shell and artifacts. They relate all but a few of these beach deposits to erosion of a natural levee or shell ridge. The remaining beach deposits may have been situated on the tops of natural levees or shell ridges previously destroyed by shoreline transgression.

According to Gagliano et al. (1982:46), the archeological deposits that occur on the shore of Lake Salvador are true in situ lake shore sites. They claim that these lake shore sites lie on the natural levees of small crevasse channels where they enter the lake, or on the transgressive beaches that fringe the lake. However, they fail to demonstrate that the shoreline occupied its present position at the time the sites were in use. The dynamic nature of the delta plain suggests that the shoreline of Lake Salvador very likely has migrated only recently to the position of these sites.

Marshes

Seemingly isolated occurrences of archeological deposits commonly occur within the marshes and swamps of the Mississippi Delta Plain. Many of these sites lie on natural levees buried by the vertical accretion of swamp deposits (Gagliano et al. 1975; 1979; Wiseman et al. 1979). Other sites classified as inland swamp sites, e.g. 16SMY30 and 16SMY33 of Smith et al. (1986), are buried sites that have been revealed by dredging; they represent sites lying on natural levees or other similar landforms that have been buried completely beneath marsh deposits. Finally, a few of these archeological deposits actually are associated with the marsh and backswamps of the delta plains, e.g. 16SMY40 of Smith et al. (1986). An examination of the Louisiana Division of Archaeology files reveals that these archeological deposits typically are located on the banks of either tidal channels or bayous.

Within the Lake Ponchartrain Marginal Basin and the adjacent St. Bernard Coastal Region, construction activities often have uncovered buried archaeological deposits within the marshes of the Mississippi Delta Plain. For example, during the 1950s and 1960s, construction associated with the building of navigation canals and highways revealed the presence of three significant Poverty Point Sites within the marshes near Lake Pontchartrain. These sites, the Bayou Jasmine (16SJB2), Linsey (16OR40), and Garcia (16OR34) sites, in many ways typify buried sites found within the marshes of the Mississippi Delta Plain.

These sites were not originally within the marsh. Rather, they were all built upon elevated, dry natural levees of distributaries of the Metairie Delta Complex. Since their occupation and abandonment, these sites and the natural levees on which they lie have subsided and have been buried by the vertical accumulation of about 2 to 2.5 m of marsh deposits (Gagliano and Saucier 1963; Gagliano et al. 1975).

These sites illustrate the problems associated with buried sites within the Mississippi Delta Plain. For example, because these shell middens and the distributary levees on which they lie are completely buried under marsh sediments, they typically lack any indications of their presence. Typically, only construction activities, e.g. canal dredging and construction of bridge piers, which deeply disturb marsh deposits and bring spoil to the surface, reveal their presence. Unfortunately, as in the case of the Linsey and Garcia sites, discovery of a buried site often results in the destruction of all or a significant part of it (Gagliano and Saucier 1963; Gagliano et al. 1975).

Sites buried within marshes also are difficult to study. At Bayou Jasmine, for example, an elaborate cofferdam was constructed to conduct the excavations (Neuman 1976). Even then, the excavations failed to reach the in situ Poverty Point component. This Poverty Point component, as at other buried sites, e.g. the Linsey and Garcia Sutes, had to be reconstructed from artifacts recovered from the spoil banks created either by bridge construction or by canal dredging. At the Linsey site, the bucket of the mechanical dredge was large enough so that intact blocks of the site could be examined. From these blocks, well-preserved artifacts and faunal remains could be recovered and stratigraphic bedding as thick as 30 cm were recognized.

Effects of Delta Progradation on Archeological Deposits

While a delta is actively building seaward, two processes have a profound affect on the surface and subsurface distribution of archeological deposits. These processes result in either preservation, burial, or destruction of the associated archeological deposits. The two processes are vertical accretion and channel widening.

Vertical Accretion. Initially, the formation of crevasses within the natural levees of the distributaries produces small subdeltas that coalesce to form the delta plain. However, as shown in Chapter IV, the deltaic plain is an actively subsiding surface. As this surface subsides, the initial subdeltas sink, and younger subdeltas build out over them (Coleman and Gagliano 1964). Although this process maintains the delta plain, it results in the burial of the oldest sites associated in conjunction with the formation of the delta plain. Later, as distributaries are abandoned and development along the main channel leads to the formation of marshes, the surrounding delta plain and its associated distributaries are buried by organic sediments (Fisk 1960; Kosters 1987, 1989).

Channel Widening. At the leading edge of a seaward-building delta, the flow of a river is divided among a number of distributaries. As the delta builds seaward, the distributary which is most favorably aligned to receive the flow will increasingly capture the flow of other distributaries. As the volume of water flowing through the favored distributary increases, it widens and deepens its channel and increases the height and width of its natural levees. During the development of the favored distributary, the other distributaries atrophy, and eventually are abandoned. In time, the channels of abandoned distributaries fill with sediment and their natural levees are buried by the aggradation of marsh (Fisk 1960).

As a delta builds seaward, one distributary becomes the main channel; the others are abandoned. Archeological deposits present on the distributary that eventually becomes the main channel are destroyed as the channel widens to accommodate the full flow of the river. As the channel widens to accommodate the increased flow, the buried natural levees that formerly flanked it are eroded and the associated archeological deposits are destroyed. As a result, the archeological deposits which accumulate on the levees of a distributary that becomes the main channel, fail to be preserved even as buried sites. Only after

the distributary becomes established as the main channel, will archeological deposits that form on its levees be preserved as buried sites. Along abandoned distributary channels sites that are buried within the natural levees and present on their surface are preserved. However, the abandoned distributaries and their levees will be buried quickly by the vertical accumulation of deposits associated with crevasse splays or the accumulation of organic sediments.

Lateral Migration. Although lateral migration plays a major role in site destruction within the alluvial plain, it is a relatively insignificant process within the delta plains. Within the Mississippi Delta Plain and the southernmost part of the alluvial plain, the presence of thick deposits of backswamp, marsh, or prodelta clays limits the ability of the Mississippi River to migrate laterally. As a result, the meander belt of the Mississippi River decreases sharply in width south of Baton Rouge (Fisk 1960; Kolb and Van Lopik 1966:30-31). This process very slowly reworks the adjacent natural levees along the lower part of the Mississippi River. The lack of significant lateral migration probably explains the unusual association of archeological deposits with segments of the Lower Mississippi River.

Summary. Archeological deposits which form during the development of a channel from a distributary to the main channel are eventually destroyed. Archeological deposits associated with abandoned distributaries are buried first by natural levee deposits and later beneath marsh and crevasse splay deposits. As a result, the archeological deposits that occur as surface sites at any time during the development of a delta probably represent an extremely biased reflection of the original settlement pattern.

Effects of Transgressions on Archeological Deposits

As discussed in Chapter IV, once a delta complex in the Louisiana Coastal Zone is abandoned, it subsides into the Gulf of Mexico. The result of the subsidence is the landward movement of the shoreline, i.e., a "transgression," over the delta plain. During a transgression, three processes serve to destroy the delta plain and the aggradational and archeological deposits that form it. Two of these processes, shoreface erosion and tidal channel migration, erode the shoreline of the delta plain. Landward of this shoreline, the enlargement of the delta's lakes and interdistributary bays that occurs in response to relative sea level rise destroys the delta plain and the aggradation of sediments that comprise it.

Shoreface Erosion. Once a deltaic complex is abandoned, the delta plain will develop a barrier shoreline that evolves according to the previously discussed model of Penland et al. (1981). As this shoreline evolves, it migrates landward over the delta plain and cuts into the delta complex. Commonly, a marine transgression will destroy both the delta plain and the aggradational facies that form it (Penland et al. 1985:203-207).

The submerged portion of a shoreline, called a "shoreface," is that part which actively erodes the upper part of the delta complex. During tropical and extratropical storms, sediments are eroded from the shoreface and redeposited further seaward. This erosion causes the shoreface to migrate landward as it cuts deeply into the delta complex. Concurrently, a minor fraction of winnowed sediment is washed landward, building up a berm in front of the advancing shoreface. As the shoreface moves shoreward, it cuts an erosion surface called the "ravinement surface." Within the Mississippi Delta Region, the upper six to eight meters of a delta complex will be removed by erosion as the shoreface migrates inland. Because archeological deposits lie on the delta plain or within the aggradation facies that form this surface (Figure 3), shoreface erosion accompanying a marine transgression will completely destroy any archeological deposits within its path (Penland et al. 1981; Nummedal and Swift 1987:244-245).

Tidal Channel Development. During the submergence of a delta complex, the development of tidal channels usually has a devastating impact on surficial and buried archeological deposits. Levin (1990) demonstrates that the erosion of deltaic headlands form flanking barriers, and that tidal channels between

these islands develop preferentially within the submerged deltaic distributaries. The action of tidal currents will initially deepen and widen a distributary channel and, as a result, will destroy natural levee deposits that flank the channel of the former distributary. Eventually, a tidal channel will laterally migrate and erode additional natural levee deposits associated with the former distributary. Any archeological deposits within the eroded natural levee will be reduced to an erosional lag at the base of the tidal channel fill (Levin, 1990).

If unrecognized, tidal modification of deltaic distributary channels can lead to overly optimistic estimates of the extent that archeological deposits survived the Holocene transgression. Many of the shallow channels identified as deltaic distributaries on high frequency seismic profiles, e.g. Stright (1986:616), are distributary channels that have been substantially modified or completely destroyed by tidal channel development or migration (Penland et al. 1985). Whatever archeological deposits may have once been associated with these channels have been destroyed partially or completely. As a result, estimates of the abundance of intact archeological deposits based upon the abundance of numerous shallow channels seen in high-frequency seismic profiles within the Louisiana Continental Shelf may be overly optimistic.

Bay and Lacustrine Shoreline Erosion. A marine transgression of a delta complex also causes erosion landward of the inland-moving shoreline. As the relative sea level rises, the shorelines of interdistributary bays and lakes move into the swamp and marsh. As the shoreline moves inland, it erodes the underlying deltaic sediments which consist mostly of marsh and unburied to completely buried natural levees. Any archeological deposits associated with the natural levees will be eroded. As previously discussed, eroded archeological deposits incorporate into transgressive beaches (Wiseman et al. 1979; Treadwell 1955).

Relict Delta Rule

Within the Mississippi River Delta, various investigators have stated that the maximum occupation and utilization of either a delta plain or a distributary by prehistoric cultures occurs after its abandonment. Typically, a delta or distributary was occupied soon after it was built above either swamp or water level. However, the use of the delta plain by prehistoric cultures continued and often peaked after it became inactive. In some cases, investigators have assumed that occupation of the delta plain did not occur until after the delta plain or distributary became inactive. The theory that prehistoric inhabitants preferentially inhabited and utilized relict delta plains or distributaries is called the "Relict Delta Rule."

A common explanation for the Relict Delta Rule is that the biological productivity of a delta varies during the cycle of delta building. During the phase of delta building, productivity gradually rises, but still remains relatively low during the life of the active delta. Once a delta complex, lobe, or sublobe is abandoned, its productivity drastically rises and peaks during the abandonment and deterioration phases. Thus, the period of time during which a delta plain could sustain greatest occupation was limited to the abandonment and deterioration phases of its depositional cycle. The degree of productively would have greatly restricted the prehistoric cultures living within the Mississippi delta region, because they maintained a subsistence tradition established during the Archaic Stage that changed only through the grafting of ceramic complexes to this lifestyle (Gibson 1978; Duhe 1981:36-37; Gagliano 1984:37).

A more specific explanation for the Relict Delta Rule is derived from work by Byrd (1974), Beavers (1982), Brown (1984), Shenkel (1984), and Toth (1988), who conclude that the prehistoric coastal cultures were specifically adapted to hunting and gathering subsistence strategies focused upon the *Rangia* bed ecozone. Assuming that the coastal Tchefuncte, Marksville, Troyville, and Coles Creeks cultures were tied to the exploitation of the *Rangia* ecozone, these cultures would preferentially have occupied each delta complex only during the period when the productivity of the *Rangia* cuneata and related resources was high. As a result, occupation of a delta lobe would not occur until after its abandonment, because the ~~microsaline environments needed by~~ *Rangia cuneata* ~~to~~ flourish ~~could exist~~ only within a relict delta plain.

could

brackish reexamine tolerance of Rangia

It also has been proposed that the annual flooding of a delta complex directly influenced the occupation of delta plains and their distributary channels. Weinstein and Kelley (1989) suggest that the annual flooding by an active delta would have been severe enough to prevent permanent or even semi-permanent occupation of its delta plain. From excavations at the Coquilles site (16JE37), Beavers (1977:3) concluded that prehistoric cultures used the deltaic plain seasonally while the delta was active. He also concluded that prehistoric cultures established permanent settlements only when the delta plain was abandoned and annual flooding abated to tolerable levels. As a result, the Relict Delta Rule might be explained in part by the adverse affects of the extreme flooding associated with an active delta complex.

The Relict Delta Rule might also reflect a biasing of the archeological record because of differences in site visibility. The visibility of archeological deposits associated with an active delta complex will differ greatly from the visibility of the archeological deposits associated with a relict delta complex. Abundant oyster reefs and *Rangia cuneata* do not appear until a delta complex is abandoned, because of ecological constraints. If shellfish were unavailable for exploitation, archeological deposits contemporaneous with an active delta will lack shell, and the visibility to field archeologists that shell provides. Such sites, if dredged or eroded, would not have the white shell that forms prominent erosional lags or spoil piles indicative of a site location. Archeological deposits which accumulated on a relict delta would contain abundant shell. Such sites would be more readily detected, especially if they were eroded or dredged. Work by Beavers (1977:3) at the Coquilles site clearly demonstrates that archeological deposits contemporaneous with active deltas do lack shell. The lack of shell could severely bias the known archeological record of sites associated with active deltas. Thus, the degree to which active deltas were utilized might be considerably underestimated.

Finally, the sedimentological processes of delta building tend to either destroy or conceal sites associated with active delta complexes. As previously discussed, the processes of channel widening and vertical accretion preferentially destroy or bury sites related to the earliest occupation of the delta plain. Work by Beavers (1977:3) at the Coquilles site clearly demonstrates that archeological deposits which formed on an active delta plain are buried. If sites associated with active delta plains typically have been destroyed or buried, the degree to which active deltas were utilized might be underestimated severely.

Historic Impacts

Within the coastal zone, historic uses of Mississippi River meander belts and crevasses have impacted severely the archeological deposits that lie within them. Agricultural, urban, and industrial development has extensively disturbed extensive portions of the natural levees and point bars within meander belts of the Mississippi River. In addition, construction of artificial levees for flood control has led to the destruction of archeological sites along the entire length of the modern course of the Mississippi River.

Residential and Industrial Development. Because the natural levees of the modern and ancient courses of the Mississippi River are still the only dry land within an otherwise flooded or waterlogged alluvial plain, they have been the focus of urban and industrial development. Obviously, the construction of housing, commercial buildings, and industrial plants has disturbed directly the surface and subsurface of large portions of both modern and relict Mississippi River natural levees. However, the roads, railroads, pipelines, and cables needed to connect towns and businesses also have torn up large swaths of land. Undoubtedly, urban and industrial development has destroyed a significant number of archeological sites within the Mississippi River Alluvial Valley.

Agricultural Disturbance. The natural levees of the active and abandoned courses of the Mississippi River and major trunk channels are sufficiently fertile and well-drained for agricultural uses. As a result, they have been extensively developed for the production of sugar cane and rice. Both types of farming have disturbed severely significant portions of the Mississippi Delta Plain (Goodwin, Hinks et al. 1991). The production of sugarcane also has impacted severely the upland areas of many of the salt domes (Brown

1980:114-115). The affects of rice farming have been discussed previously in regard to the Prairie Terrace. Also, the affects of sugar cane farming have been discussed previously, with regard to the Mississippi Alluvium Plain. As a result, both discussions are not repeated in this section of the report.

Construction of Artificial Levees. Artificial levees have been constructed all along the course of the Mississippi River in order to control annual flooding. The construction of these levees has impacted severely the natural levee and associated archeological deposits buried within it or resting on its surface (Castille 1979; Goodwin, Hinks, et al. 1989). The specifics of artificial levee construction and its affects on archeological deposits have been discussed previously with respect to the Mississippi Alluvial Plain. Therefore, these discussions are not repeated here.

Dredging. During the construction of canals and pipelines within the Mississippi Delta Plain, dredging operations often uncover archeological deposits. Even when all or part of a buried site is destroyed and its former deposits are stacked in spoil piles, useful data often can be recovered from this material. If suction dredges were employed, archeological deposits will be completely dispersed and mixed into a slurry. Large or delicate artifacts probably will be fragmented. Within the spoil disposal area, the slurry will be discharged from a tail pipe. When the sediment is discharged at the tail pipe, it is sorted according to weight; the heavier materials accumulate as a spoil cone and the lighter materials are washed away from the cone. As a result, the artifacts will be concentrated within the spoil cone. If a site is dredged using a dragline, the resulting spoil deposits may consist of intact blocks of the archeological deposit. These blocks may contain relatively undisturbed samples of artifacts, faunal remains, and floral materials (Gagliano et al. 1975:59, 232; Gagliano 1984:30-31).

Therefore, more dredging operations should be either monitored or have their spoil piles examined within a couple of months after they have been piled. Examination of the spoil from dredging operations often is the only source of data concerning the presence of buried cultural deposits within an area. If spoil piles are not examined soon after they are constructed, vegetation will cover these deposits and conceal any cultural materials. For example, two buried Poverty Points sites, the Bois d' Arc #1 and #2 (16TR212 and 16TR213) were accidentally discovered this way on fresh spoil piles in the Terrebonne Coastal Region (Gagliano et al. 1975:232; Weinstein and Kelley 1990).

Dredging also impacts the integrity and visibility of archeological deposits. It has been suggested that the dumping of spoil buries and conceals archeological deposits along the banks of rivers and bayous. Partial burial of sites by spoil often makes it difficult to determine characteristics of such sites, such as integrity, size, artifact content, and landform association. Finally, the placement of spoil over archeological deposits often disturbs them (Gibson 1976a:82; 1976b:4; Tribble and Garrison 1982).

Bank Erosion. The abandoned course, many distributaries, and artificial channels within the Mississippi Delta Plain carry substantial recreational or commercial traffic. The constant use of these waterways creates substantial wave action from the wakes of this river borne traffic. Along the lower part of the Mississippi River, large ships create substantial wave action. The constant wave action generated from river traffic, together with that generated by wind and current action, cause extensive erosion of the unprotected banks of a river course, canal, bayou, or other water course. A brief examination of the Louisiana Division of Archaeology files demonstrates that bank erosion is an extremely serious threat to archeological deposits. A majority of the prehistoric archeological deposits along waterways such as Bayou Chene and Bayou Beouf have been significantly damaged by bank erosion. Gagliano et al. (1975; 1982), Wiseman et al. (1979), and Weinstein and Kelley (1990) demonstrate that bank erosion along lakes, bayous, and artificial channels seriously impacts the archeological deposits situated along their banks. Like shoreline erosion associated with land loss, bank erosion is a serious threat to archeological deposits.

Summary

The processes that either construct or destroy a delta complex inevitably bias the archeological record by either the destruction or burial of archeological deposits. The archeological deposits that occur as surficial sites are an extremely biased sample of the original settlement pattern for any specific cultural group. As a result, there will be significant differences between the distribution pattern of sites recorded for any specific cultural group during archeological surveys, and the group's original settlement pattern. Therefore, within the Mississippi Delta Plain, the assumption that the distribution of sites recorded by a site survey is the same as or representative of the original settlement pattern cannot automatically be presumed to be valid. Many of the processes that erode and rework the delta plain affect the aggradational facies with which archeological deposits are associated the most. As a result, when a piece of the delta plain is lost to coastal erosion or subsidence, the archeological deposits associated with that piece of the delta plain are usually devastated. The loss of land within the Mississippi River Delta Plain fails to simply submerge the archeological deposits; rather it results in the destruction of these archeological resources. Bank erosion along the waterways of Louisiana also is currently destroying and damaging many archeological deposits.

The Chenier Plain

Unlike the adjacent Mississippi River Delta, the Chenier Plain is a relatively stable surface. Within the Chenier Plain, archeological deposits occur upon coastal ridges and natural levees, and in the marshes along the shores of lakes and river channels.

Ridge and Natural Levee Sites

The prime location for archeological sites on the Chenier Plain are the relict ridges, which consist of cheniers, beach ridges, and recurved spits that comprise each of the five ridge systems. The four largest sites and sites with mounds lie on these ridges. Also, about half the remaining sites occupy a section of ridges. Typically, these sites are located on cheniers where modern or ancient bayous brush against the ridges, where two or more cheniers join, or where a lake or bay lies against a ridge (Gagliano et al. 1982:26-32; Shelley 1980; Penland and Suter 1989).

As noted in Chapter III, the various ways in which these ridges formed precludes either the accumulation of or preservation of archeological deposits during the formation of the cheniers, beach ridges, and recurved spits. Thus, archeological deposits occur only on the surfaces of these ridges, except where buried by marsh sediments or by human agencies. These ridges have extremely limited potential for containing deeply stratified archeological deposits that natural levees possess (Gagliano et al. 1982:26-32; Penland and Suter 1989).

Typically, these sites contain multiple components, despite *Rangia* shell middens that are less than a meter thick. For example, the Veazey Site (16VM7) is a large site that lies on the chenier Pecan Island, at its junction with several other ridges. Despite its thinness, the midden of the Veazey Site is distinctly stratified. This 50 to 60 cm thick midden contains Tchefuncte, Marksville, Troyville, Coles Creek, and Plaquemine components. Similarly, the thin midden of the Pierre Clement Site (16CM47) has Coles Creek, Plaquemine, and Mississippian-like components. Finally, the 35 cm thick midden of the Jeff Simmons Site (16CN48) contains late Coles Creek and Plaquemine components (Gagliano et al. 1982:26-32).

In addition to the ridges, a short segment of natural levee occurs along an abandoned Sabine River course. Upon it lies the Smith Ridge Site (16CM49). Except for the landform on which it lies, this site fails to differ significantly from the previously described ridge sites (Gagliano et al. 1982:26-32).

Marsh Sites

Archeological deposits consisting of shell middens occur within or on the banks of the bayous and rivers within the marshes of the Chenier Plain. The shell middens along both Mermentau River and Bayou Lacassine primarily occur on the cutbank side of their channels. In contrast, the shell middens along the Calcasieu River appear to occur primarily along the crossings of meander loops and channel reaches. Along the Sabine River, the shell middens occur scattered along its banks, with one located at each confluence with a bayou or slough. Also, they occur along the banks of its "tributary" bayous and sloughs. The shell middens along all of these rivers and bayous are associated with a variety of cultures ranging from Tchefuncte to Mississippian (Gibson 1976; Beavers 1978; Burden et al. 1978; Tribble and Garrison 1982).

The geomorphic settings of these shell middens are unclear. For example, it is uncertain whether the apparent occurrence of sites on the cutbanks of both Mermentau River and Bayou Lacassine reflect either cultural preferences for cutbanks, or cutbank erosion (Gibson 1976:74; Burden et al. 1978;36). Also, it uncertain whether these sites were built on natural levees that have been buried by marsh, or were built directly within the marsh. Because most of these sites have been totally destroyed by bank erosion, dredging, and pothunting, little is known about the people and processes that formed these sites.

Shell middens also have been found along the shores of Grand Lake and Sabine Lake within the Chenier Plain. Almost nothing is known about the sites on Grand Lake, except that they consist mostly of two wave-washed lags of *Rangia* shell containing scattered artifacts. Numerous shell middens crowd long segments of the Lake Sabine shoreline. These archeological deposits consist of *Rangia* shell middens which contain abundant bones of mammals, fish, birds, and turtles, and numerous artifacts (Beavers 1978; Burden et al. 1978).

Lateral Accretion

Within the Chenier Plain, lateral accretion, rather than vertical accretion, has been the major process resulting in the preservation of sites. After transgressive shoreline erosion formed the cheniers, lateral accretion preserved the cheniers and the former shoreline on which they were formed. Periodically, mud accumulated as mudflats along the shorelines resulting in the outward building, or "progradation" of the coastline. Lateral accretion of mudflats in front of the cheniers helps to protect them during periods of coastal erosion. As a result, lateral accretion can preserve sites; this observation contradicts statements by Britsch and Smith (1989:246). The above situation illustrates a significant misconception by Britsch and Smith (1989:246). They conclude that lateral accretion or marine transgression sites or archeological deposits will be destroyed by erosion. However, within the Chenier Plain, lateral accretion does not destroy archeological deposits; rather, it preserves them. Nor does lateral accretion destroy archeological deposits within the adjacent delta plains, as claimed by Britsch and Smith (1989:246). From a strict sedimentological view, they have confused cause and effect; cut bank erosion and lateral accretion are the result, but not the cause of lateral migration (Allen 1985). Because it is cut bank erosion that destroys sites, it is lateral migration, rather then lateral accretion that destroys sites. Therefore, the correct statement is that lateral migration and marine transgression destroy sites.

Site Destruction

Many of the ridge and natural levee sites within the Chenier Plain are in relatively good condition. However, several of these sites have been destroyed or damaged by the recent development of the Chenier Plain. Bank erosion and dredging have seriously damaged some of the sites adjacent to either lake or channel banks (Gagliano et al. 1975; Tribble and Garrison 1982).

Most, if not all, of the known marsh sites within the Chenier Plain either have been destroyed or damaged seriously. Bank erosion caused by river traffic wakes, storm surges, and flood currents has

reduced the majority of marsh sites along Mermentau River, Bayou Lacassine, and Calcasieu River into shell beaches containing scattered artifacts. A significant number of sites along the Sabine River retain varying degrees of integrity. A few, in fact, exhibit features that might be related to prehistoric structures (Gibson 1976a; Beavers 1978; Burden et al. 1978; Tribble and Garrison 1982).

CHAPTER VI

CONCLUSIONS

by Paul V. Heinrich

Assessments can be made pertaining to the occurrence of archeological deposits by cultural affiliation, using the archeological data available from both published reports and the site files of the Louisiana Division of Archaeology together with current geomorphological research. First, for each of the major physiographic divisions within the Louisiana Coastal Zone, archeological deposits were found to occur preferentially on a set of landforms specific to each physiographic division (Table 1). The potential for the occurrence of deeply buried or stratified sites was assessed preliminarily for each of these landforms, using sedimentological principles and well known archeological sites as analogies, where possible. The differential utilization of specific landforms between the different cultural stages within the Prairie Terrace Physiolographic Division of Neuman (1984) also is noted. In the other physiographic divisions, such differential utilization of landform types failed to emerge, possibly because of the lack of comparable settlement.

Second, information concerning the sedimentology, geomorphology, Quaternary geology, and archeology of the coastal zone can be combined to produce assessments of the cultural affiliations and distributions of archeological deposits that can be expected within individual geomorphic regions (Table 2). This type of assessment can elucidate which archeological deposits may have been present, but were destroyed by erosion or were buried by sedimentation. As a result, this information can be used to assess the degree to which settlement patterns have been distorted by the dynamic geomorphic processes which continually reshape the coastal zone.

Finally, if detailed geological and archeological data are available, this type of analysis can be done for areas that range in size from survey areas to geomorphically distinct subdivisions of geomorphic regions. In the case of the Amite River, both detailed geologic mapping and archeological surveys are available. As a result, the cultural affiliation and distribution of archeological deposits can be assessed; a set of expectations involving these deposits has been produced as an example of what can be done (Table 3). In this case, geologic mapping can be used in part to predict the general distribution of sites and to assess the extent that settlement patterns have been altered by geologic and geomorphic processes. In the case of the Amite River, a substantial part of the archeological data base remains to be utilized.

One aim of this report was to review current research concerning the archeological geology of the Louisiana Coastal Zone. Unfortunately, this discussion, out of necessity, has concentrated on theoretical relationships, rather than observed relationships. Unlike the Great Plains, Osage Plains, and the Upper Mississippi Valley, recent detailed studies concerning the archeological geology of both sites and survey areas within the Louisiana Coastal Zone are very rare. As a result, the data needed to generalize about matters such as site formational processes and other aspects is sadly lacking within the coastal zone.

For example, little information exists concerning the formation of deeply buried sites on natural levees and their associated distribution. Equally, little has been published about the sedimentology and stratigraphy of these deeply stratified sites, e.g. the Coquilles, the Bruly St. Martin, and Ruth Canal sites, that have been either tested or found within the Coastal Plain as part or separately from the site report. Traditionally, it has been assumed that rates of sedimentation, processes of burial, and similar factors have had no effect upon these archeological deposits. However, in the case of the Bruly St. Martin site, the lack of any sedimentological and pedological data leaves interpretation of cultural materials recovered inconclusive.

The distribution of buried sites is another case in which additional efforts need to be made to recover data needed to answer questions about their occurrence. Examination of both survey reports and

As a result, it is difficult, if not impossible, to determine the affect site formational processes have had on the archaeological record

? 180° wrong Kniffen and Russell talked about it McIntire? Gagliano

Table 1. Listing of Preferred Locations of Archeological Deposits by Physiographic Division

PRAIRIE TERRACE
1. Terrace Scarp and Edge of Streams, Alluvial Valleys, and Estuaries (S)
2. Pimple Mounds Adjacent to Alluvial Valleys (S)
3. Relict Natural Levees of River Course and Crevasse Distributary (S) (Meso- and Paleo-Indian)
4. Relict Point Bar Ridges (S) (Meso- and Paleo-Indian)
5. Relict Interchannel Areas (S) (Neo-Indian)
6. Sand Hills (S)
7. Alluvial Valleys a. Natural Levees, Especially at Cutbanks and Confluences (S & B) b. Terraces, Point Bar Ridges and Edges (S & B)
MISSISSIPPI RIVER ALLUVIAL VALLEY
1. Natural Levees (S & B) a. Abandoned River Channels and Courses and Crevasse Distributary b. Active River Courses and Crevasse Distributary c. Bayous in Interdistributary Basin
2. Relict Meander Belt (S & B)
3. Banks of Bayou within Interdistributary Basin (S?)
4. Shorelines of Interdistributary Lake (S?)
MISSISSIPPI DELTA PLAIN
1. Natural Levees (S & B) a. Trunk Channels, especially at Confluences b. Distributary, especially near its Head and at Confluences
2. Mouth of Active Distributary (S?)
3. Banks of Channels within Subdeltas (S)
4. Accretion Ridges (S)
5. Relict Barrier Islands (S)
6. Shell Ridges (S & B)
7. Salt Domes (S & B)
8. Marshes (S & B) a. Buried Sites (on Older Natural Levees, etc.) b. Banks of Bayous and Tidal Channels

CHENIER PLAIN
1. Coastal Ridges (S) a. Confluence with Other Ridges b. Lie Against Bayous, Rivers, and Lakes
CHENIER PLAIN continued
2. Natural Levees (S)
3. Marshes (S & B) a. Buried Sites (on Older Natural Levees, etc.) b. Banks of Rivers, Bayous, and Tidal and Other Channels
NOTE: S = surface archeological deposits expected B = buried archeological deposits expected

remove

Table 2. Preliminary Assessment of Expectations for the Occurrence of Archeological Deposits by Cultural Component within the Geomorphic Regions of the Louisiana Coastal Zone. (Expectations based upon both geological history and recorded sites.)

PHYSIOGRAPHIC REGIONS GEOMORPHIC REGIONS	CULTURAL COMPONENT						
	PI	Ar	Pp	Tc	Ma	Ct	MI
PRAIRIE TERRACE							
Relict Plains	S	S	S	S	S	S	S
Modern Alluvial Valleys	B/N	S&B	S&B	S&B	S&B	S&B	S
MISSISSIPPI RIVER ALLUVIAL PLAIN							
Meander Belt No. 3							
Loess Covered Terrace	S	S	S	S	S	S	S
Lake LaPointe M.B.? — spell out	N	S&B	S	S	S	S	S
Bayou Teche M.B.? — spell out							
outer natural levee	N	S&B	S	S	S	S	S
middle natural levee	N	B	S&B	S&B	S	S	S
inner natural levee	N	N	N	S&B	S&B	S	S
Meander Belt No. 1	N	N	D?	B	S&B	S&B	S&B
Atchafalaya Basin	D/N	D/N	D/N	N?	S&B	S&B	S&B
MISSISSIPPI DELTAIC PLAIN							
Pontchartrain Marginal Basin	Dp	S&B	S&B	S&B	S&B	S&B	S
St. Bernard Coastal Region	Dp	N?	B	S&B	S&B	S&B	S
Plaquemine Coastal Region	N	N	N	Dd?	Dd?	Dd?	S&B
Barataria Interlobe Basin	Dp?	N	N	S&B	S&B	S&B	S
Lafourche Meander Belt	N	N	N	B?	B?	B?	B?
Terrebonne Coastal Region							
eastern and central	Dp?	Dd?	N	N	S&B	S&B	S
western	Dp?	Dd	B	S&B	S&B	S&B	S
St. Mary Coastal Region							
delta plain	Dp	Dd	B	B	S&B	S&B	S
salt domes	S&B	S&B	S&B	S&B	S&B	S&B	S&B
CHENIER PLAIN	Dp	Dp	N	S	S	S	S

M.B.? " " "

M.B. = Meander Belt

LEGEND

B = Buried sites
BS = Buried and surface sites present
D = Deeply buried sites
Dd = Deeply buried sites within underlying delta complex
Dp = Deeply buried sites on underlying Prairie Terrace
N = No sites present, because of erosion or lack of occupation
S = Surface sites
(& = and; / = or; ? = very uncertain)

Pi = Paleo-Indian
Ar = Archaic/Meso-Indian
Pp = Poverty Point
Tc = Tchefuncte
Ma = Marksville
Ct = Troyville-Coles Creek
Mi = Mississippian and Plaquemine

Table 3. Preliminary Assessment of Expectations for the Occurrence of Archeological Deposits by Cultural Component within the Amite River Valley. (Expectations based upon both geological history and recorded sites.)

GEOMORPHIC REGIONS	CULTURAL COMPONENT						
	Pi	Ar	Pp	Tc	Ma	Ct	Mi
Adjacent Prairie Terrace	S	S	S	S	S	S	S
Amite River Valley							
Magnolia Bridge Af.	N	N	B/N	~~S&B~~	~~S&B~~	~~S&B~~	~~S&B~~
Denham Springs Af.	N	S&B	S&B	~~S&B~~	~~S&B~~	~~S&B~~	S
Watson Alloformation	B/N	S&B	~~S&B~~	~~S&B~~	~~S&B~~	S?	S

remove question mark

LEGEND

Af. = Alloformation
B = Buried sites
B&S = Buried and surface sites present
D = Deeply buried sites
N = No sites present, because of erosion
S = Surface sites
(& = and; / = or; ? = highly uncertain)

Pi = Paleo-Indian
Ar = Archaic/Meso-Indian
Pp = Poverty Point
Tc = Tchefuncte
Ma = Marksville
Ct = Troyville-Coles Creek
Mi = Mississippian and Plaquemine

site excavations reveals that rarely are attempts made to test for buried components, even at known sites. Generally, once sterile soil is encountered beneath cultural materials within a test pit, excavation is stopped after a level or two. Even at known sites that are being excavated, test pits, auger holes, or push tube samples generally are terminated once the depth of the surface site has been determined. As a result, little information exists regarding the distribution of buried components.

Furthermore, the broad outline of site distribution relative to landforms and soils has been delineated by various archeological surveys. At this time, the potential for a given landform to have an archeological deposit on it generally is known. However, these surveys tactfully ignore the problem of distinguishing between distribution patterns and settlement patterns in reconstructing settlement patterns and "man-land" interactions.

Within most of the Louisiana Coastal Zone, sedimentological processes either will tend to destroy selectively by erosion or to conceal by burial specific types and classes of sites, because of the depositional environment in place at the time in which they were formed. As a result, distribution patterns may only reflect a very distorted view of any original settlement pattern. This report demonstrates that the coastal zone is a highly dynamic system in which the original settlement patterns have been altered severely to produce the distribution patterns recorded by archeological surveys today. Unfortunately, because of a lack of sufficient data, specific processes by which the archeological record is altered can be hypothesized, but not yet tested.

Geologists and others are making continuing progress in understanding the Quaternary geology, geomorphology, and sedimentology of the coastal zone. Unfortunately, apparently very little of this ongoing work comes to the attention of archeologists working in coastal Louisiana. Similarly, these geologists and geomorphologists seem unaware of archeological work that either compliments or challenges work in which they are involved. The interaction of geologists and archeologists during the 1940s and 1950s, which produced spectacular results in understanding the cultural and geological evolution of the coastal zone, needs to be revived. This report attempts to show that the application of new concepts in stratigraphy, e.g. allostratigraphy, and in sedimentology have significant applications to archeological studies within the dynamic coastal zone.

Finally, examination of numerous archeological surveys and site files from the Louisiana Division of Archaeology clearly demonstrates that associated with land loss is an equally devastating loss of archeological resources. When any land is lost along the coastline and within the delta plain, the archeological deposits on it very likely are destroyed, rather than simply submerged. A number of processes specifically erode and rework the delta plain and the aggradational facies which form it. Because the majority of archeological deposits rest on or lie within this surface and sedimentary facies, their destruction results in the destruction of the associated archeological deposits.

It is hoped that by further delineating the processes which affect archeological site preservation, archeologists and geologists, as well as others, can work to better understand man's interaction within the ever-changing coastal zone. This should result in a greater understanding of man's distribution throughout the area, and should put us one step closer to understanding early man's relationship with his surrounding environment.

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PERSONAL COMMUNICATIONS

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At R. Christopher Goodwin & Associates, Inc., William P. Athens served as Project Manager. Shirley J. Rambeau, Karen Adoue, and Cara Robertson prepared the graphic materials for inclusion in this report. Christine Herman supervised report production.

APPENDIX I

SCOPE OF SERVICES

Scope of Services

This project involves the compilation of a database relative to the cultural resources of the coastal zone. It would involve an investigation sufficient to describe and document the nature and extent of the resources, an evaluation of previous efforts to identify these resources and an evaluation of the potential significance of the resources. This evaluation should not be limited to archaeological resources but should deal with all cultural resources.

Task 1: Prepare an inventory of known cultural resources within the coastal zone. This will include a map set (7.5' USGS Quadrangles) with appropriate designations etc. for site/occurrence type, as well as copies of all relevant site data.

Deliverable: Map atlas and report detailing efforts. (Report: 1 original and 4 copies)
Benchmark Date: 28 February 1990

Task 2: Prepare an evaluation of previous work within the coastal zone. This will include a description of the efforts as well as the results.

Deliverable: Report detailing the above effort. (Report: 1 original and 4 copies)
Benchmark Date: 30 April 1990

Task 3: Prepare an analysis of the current level of knowledge with respect to the cultural resources of the coastal zone. This should include discussions concerning all areas where there is insufficient data to determine the significance of the extant resource base.

Deliverable: Report detailing this effort. (Report: 1 original and 4 copies)
Benchmark Date: 30 August 1990